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Access Control & Security Alarm System for BTS Management with Microcontroller

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Abstract — This paper describes the design of Microcontroller based security and Access control system for use in Mobile base station premises. The system combines Microcontroller technology and Mobile Network to accomplish the required task. When the Visitor sends Short Message Service (SMS) to the centre office, the Centre office detects a mobile number, and then the system captures the user image and scans the database for a match. If both the Database image and captured image belong to a registered user, access is granted. When an unauthorized user opens the base station door without permission from centre office system turns on the alarm and the system captures the unauthorized user image. That system captures and sends the unauthorized user image to the centre office and the system turns on the alarm.

Keywords— Mobile Base station, Access control, Microcontroller, Camera, Email

I. INTRODUCTION

More than ever, the security of your facilities is essential. In the past, door locks and alarm systems were the only options to keep your property safe. After handing over the keys to the employees, the maintenance, and sanitation staff, everyone accessed the building 24/7. Each time the keys were lost, the business owner had to pay the cost of recovering the locks.

Accessibility is an efficient and affordable option to ensure its installation. With an access control system, it is possible to avoid unauthorized visitors, manage the accessing of employees and, restrict access to certain areas of your property. Access control systems can be adapted to the 41 needs of your business in terms of performance, flexibility, and cost. You can determine the level of security based on the right balance between safety and convenience for you and your employees.

With access control protection, you will know who enters your business, when they enter, and what door they used. Using the reporting interface, the viewer will receive detailed reports and reports of all activities within your facilities. In addition, you can designate protected areas and make them available only to authorized employees.

To overcome this security threat, a security system using microcontrollers and GSM technology has been proposed. This system is an access system based on a controller so that only the authorized person can access the locker using microcontroller technology.

II. LITERATURE REVIEW

The protection of telecommunications systems is an important case study for several reasons. First, many

distributed systems rely on the underlying fixed or mobile phone network in ways that are often not obvious.

Mobile network operators are spending millions of rands on replacing stolen batteries and on security following a spate of vandalism at their cell phone tower sites. Tower vandalism is a significant issue affecting not only operators but also consumers whose service may be cut off completely in some areas. Each theft incident can result in the network in that area being down for days and can severely affect businesses and individuals. "If a battery has been stolen, there is no backup, and when sites are broken into, the vandalism often means that it increases the repair time. There is a risk that if the thefts are not contained, the additional costs incurred could be passed on to the consumer, as the cost of battery replacement and tower repairs continues to escalate. Operators say battery theft is an issue of national concern, but certain areas appear to be hot-spots for criminal activity." [1] [2].

One of the technological ironies of our time, in the research group opinion, is the fact that nearly every person in the world now owns a cell phone and desires good cell phone coverage when they want to make a call, send a text or connect to the Internet.

Recommended Cell Tower Security Steps

- **Camera Surveillance:** All cell towers should be monitored remotely by camera; intelligent software and backup live personnel should be used.
- **Power and Battery Monitoring:** Similar to the situation with generators above, cell towers are critical infrastructures, which also require battery backup in the case of a power outage. These backup batteries and power to the cell station itself should be monitored remotely to ensure continuous operation of the cell tower.
- **Perimeter Defense and Access Control:** Last but not least, it is very important to include several layers of physical security to monitor and protect these important assets. A general perimeter intrusion system is required, as well as additional measures that monitor and secure the most attractive and vulnerable assets such as batteries, fuel supplies, and generators. A high-tech padlock solution such as the High-tech Access control system can add significant confidence that your most important assets are accessed only by authorized

personnel, as well as adding the capability of tracking and reporting on such access on a long-term basis.

A literature survey was carried out to gain information and knowledge. Before starting with the analysis and design of the project, many research papers, manuals, documents related to the concept of the project were referred. [3] [4]

III. METHODOLOGY

Remote site customers must ensure that the service is available when mains power is lost. The availability of services in the event of major power outages is already achieved through the use of 12V lead-acid batteries, which are attractive to criminals because of their resale value and lead recovery.

To avoid this problem, we can use this access control system.

- Can identify who has open the BTS door
- Can build up access database with Date & Time
- Can access denning unauthorized person

A. Identifying Business Values

Crime syndicates are increasingly targeting the bases of South African mobile operators, stealing or destroying critical infrastructures such as batteries, copper cables, and diesel. Hundreds of millions of mobile operators were lost due to theft and destruction of this infrastructure. Destructive and theft rates, especially several recurring events, sometimes forced operators to give up key locations due to the cost of compensation, which in some areas adversely affects network availability or quality.

Because cell towers are attractive targets for thieves and vandals, sophisticated technology must be used to track attacks and generate real-time alarms that trigger these events. There are many reasons why cell tower security should include strict physical security measures. There is a lot of diesel theft, vandalism, copper wire theft, and battery rod, especially in emerging markets. Therefore, it is important to protect wireless access points and cell towers with remote camera cameras, remote security personnel, and other measures. Intelligence detection software can be used for tracking.

B. Feasibility Analysis

The need to develop a cost-effective surveillance system through innovative technology immensely influenced the development of this project. This project will design and implement a security system based on the Raspberry Pi microcomputer. When the visitor opens the BTS door, activate a camera to take a picture and then send an alert to the facility owner through electronic mail plus an image attachment.

The next step is to assess whether some devices are more vulnerable than others. Another factor to consider is whether you think you are suffering from employee theft or theft by outside employees. This can affect employee performance device decisions. Your general geographic location may also influence the technology and machinery that best suits you.

C. Operational Feasibility

In this Telecommunication Mobile Site, a security system has been designed that has a special feature and which make a notification. This project deals with the design & development of a theft control system for Mobile Telecommunication Site, which is being used to prevent and Access control. The developed system makes use of an embedded system (comprises an open hardware microcontroller and a GSM modem) based on Global System for Mobile communication (GSM) technology. [5] [6]

D. Analysis and Requirement Gathering

A basic analysis of your situation will help you determine what kind of equipment you have and how and where you use it. If your equipment or parts are too far away for attachment, such as highway maintenance, stealing most equipment on weekends or at night, your solution should focus on both equipment and the workplace. The techniques discussed in this series are typically used in equipment rather than in premises.

The next step is to assess whether some devices are more vulnerable than others. A good thief target is a moving and relatively valuable asset, and Battery Bank Steers is a good example and is at the top of the 10 most stolen products. Another factor to consider is whether you think you will be the victim of employee theft or theft from outside employees. This can affect employee performance device decisions. Your general geographic location may also influence the technology and machinery that best suits you.

E. Design

The main idea of designing the microcontroller based digital lock locking system is to provide many modern security features than the mechanical lock.

The software application and the hardware implementation help the microcontroller read the messages sent by the user from a mobile phone or send messages to the mobile phone through the modem and accordingly change the status of the required Door lock (IN/OUT).

It works as following. [7]- [8]

1) Access Control using AT Commands: (Authorized Person)

- Send SMS to the center office using "IN" commands.
- Check the SMS & compare with the database. After that, Open the Door.
- Center office open Door using AT commands.
- Send Door open notification using Door sensor.
- Take a picture from Hide camera
- Save the picture at SD card & send to center office mailbox using 3G Dongle.
- After work is done, sends SMS to center office using "OUT" commands.
- Check the SMS & compare with database. After that, Close the Door.

2) Without Access permission (Unauthorized Person):

- Send Door open notification using Door sensor.
- Take a picture from Hide camera

- Save the picture at SD card & send to center office mailbox using 3G Dongle.

The data process has been indicated through Fig. 1 and the architecture design has been indicated in Fig. 2.

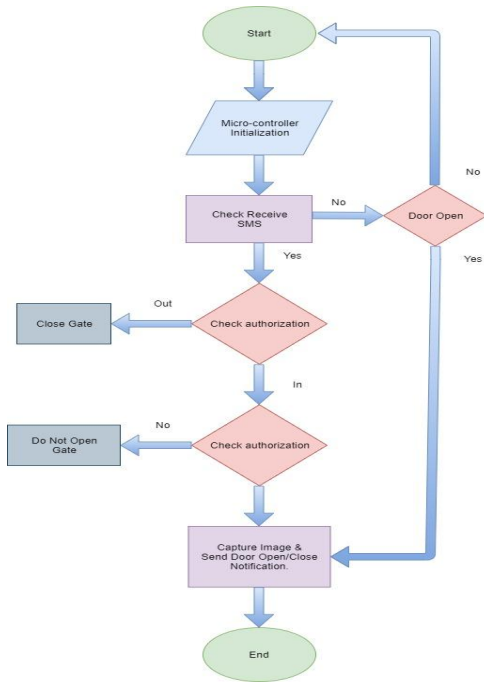


Fig. 1 Designed System

Access control systems are played a major role in telecom or IT environment where network equipment is run reliably for years over years. It has protection against Battery thieves.

In this Telecommunication Mobile Site, a security system has been designed that has a special feature and which make a notification.

This project deals with the design & development of a theft control system for Mobile Telecommunication Site, which is being used to prevent & Access control. The developed system makes use of an embedded system (comprises an open hardware microcontroller and a GSM modem) based on Global System for Mobile communication (GSM) technology.

- Control visitors using Authorized & Unauthorized.
- Image capturing who enter the Mobile base station.
- Any theft attempt Door Alarm Notification & Image capturing.
- Mobile base station Door Alarm notification.
- Create who enters the mobile base station & Site access Database.

The implemented circuit and the access control have been indicated through Fig. 3 and Fig. 4.

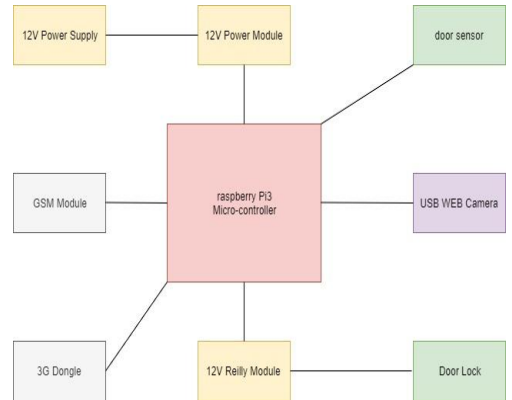


Fig. 2 Architecture Design

F. Implementation

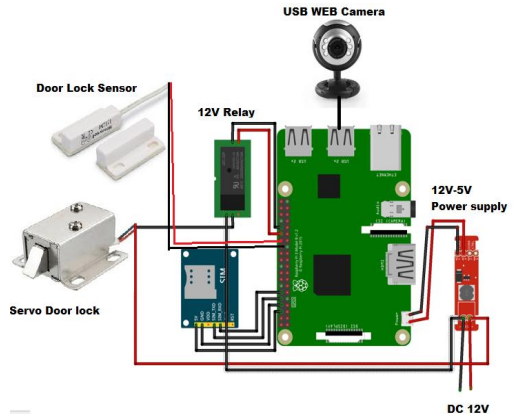


Fig. 3 Implementation Circuit Diagram



Fig. 4 Installation of the Access control system.

G. Testing

Authorized Employee access the base station.

- Mobile Telecom employees visit the Mobile base station & send the IN command using the mobile Application.

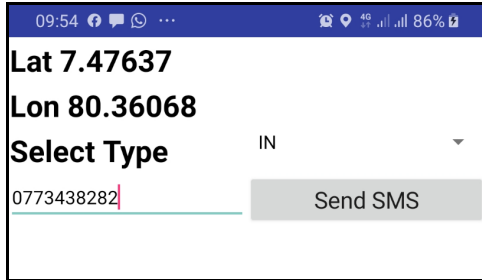


Fig. 5 Send IN Command using mobile application

- Mobile application sent the message to centre office and check the authentication with centre office database

EMP No	Employee Name	Mobile number	Picture
1	Charls Karawita	714177803	
2	Supun Pabasara	719302398	
3	Ishanka Dilshan	714541044	

Fig. 6 – Employee register database

- Servomotor will open the lock when employees register with the database.
- Magnet door sensor will send the door open signal to the raspberry web camera capture the visitor image.
- After work is done, Mobile Telecom Employee Mobile base station & send the OUT command using the mobile Application.
- Servomotor will lock the door.
- Magnet door sensor will send the door close signal to the raspberry Web camera capture the door lock image.

When an unauthorized visitor opens Mobile base station, Magnet door sensor will send the door open signal to the raspberry Web camera capture the visitor image.

H. Result and Discussions

According to project activities after constructing the circuit, testing was done.

Magnet door sensor will send the door open signal to the raspberry Web camera to capture the visitor image.

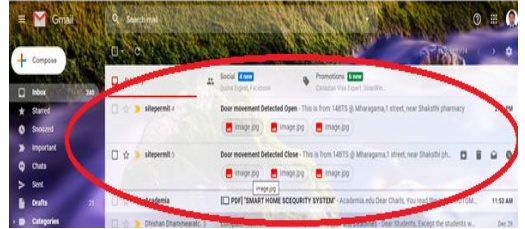


Fig. 7 Incoming Mail Alert or URL fully in Regular font

Magnet door sensor will send the door close signal to the raspberry Web camera capture the door lock image.

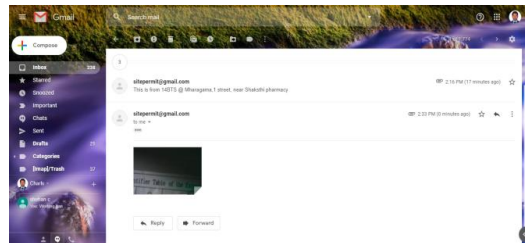


Fig. 8 Captured door close image

When an unauthorized visitor opens Mobile base station,

- Magnet door sensor will send the door open signal to the raspberry Web camera capture the visitor image.

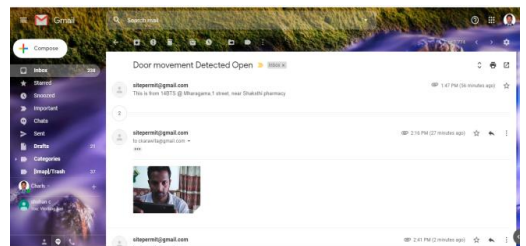


Fig. 9 – Captured Unauthorized visitor image

IV. FUTURE WORKS AND CONCLUSION

As per the future enhancements of this project, the research group hopes to develop several areas.

- Intend to use more cameras for different features and emotions.
- In the future, try to connect a live stream from a raspberry microcontroller.
- The project the group looks forward to developing this item to be available in the market and start a business of it avoiding the failures had in doing the project.

ACKNOWLEDGEMENT

First, the research group extends the heartfelt gratitude to the supervisors who gave the guidance and advice to carry out the project step by step to finish it successfully. The group also is thankful to the Head of the Department of IT Ms. Suranji Nadeeshani for the support given in all the administrative matters and providing all necessary facilities which enabled us to reach completion of the project. The group expresses my special thanks to Mr. Thilak De Silva for the encouragement and the valuable instruction given throughout the final year project.

Finally, the group expresses our gratitude and appreciation to family members who assisted me in numerous ways to achieve the goal successfully.

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Accident-Proof Headphones: An Analytical Research on How Smart Headphones Could Reduce Road Fatalities

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Abstract— Headphones are used by most people as a source of entertainment. Many pedestrians, cyclists and joggers like to use headphones while they are on the road even though it can result in extreme sensory deprivation and distraction. The purpose of this paper is to conduct a study on how the use of headphones can reduce the standard limits of human perception. It examines how this increases the vulnerability of one facing road accidents and proposes a possible solution to overcome this issue.

Keywords— Road Safety, Sensory Deprivation, Embedded Systems, Pedestrian Fatalities

I. INTRODUCTION

Death and injury levels of headphone-wearing pedestrians have risen rapidly over the years with the United States taking the spotlight with the number of injuries and fatalities tripling over the last seven years. A study conducted by Dr. Richard Lichenstein and his colleagues [1] revealed that 70 percent of the accidents which involved pedestrians wearing headphones resulted in the pedestrian’s death. The study also proved that more than a third of the fatalities were younger than 18 years and around two-thirds were younger than 30 years. Almost 90 percent of the collisions occurred in urban areas or large cities. It is also a commonly known factor that most youth today prefer to listen to music with extremely high-volume levels. Repeated exposure to sounds over 85 decibels is considered harmful and can even induce hearing loss in most humans [2]. In 2005, Warwick Williams of the National Acoustic Laboratories in Australia [3] conducted a study to compare the sound level of music being played in a headphone of a headphone-wearer with the noise level in various background environments. The results derived from the experiment showed that the volume level used in headphones ranged from 73.7 decibels to 110.2 decibels resulting in an average of 86.1 decibels from the individuals sampled. Meanwhile the typical noise levels in the background environments were in the range of 73.2 decibels. A difference of almost 13 decibels could be seen between the two.

While most studies focus only on pedestrians who are wearing headphones facing accidents, many cyclists and joggers have also faced such situations. Using a pair of headphones and listening to music while cycling or jogging can be very relaxing and help one tune out of this world. This can turn out to be quite dangerous for pedestrians, joggers and cyclists who are deprived from their basic auditory senses. This sort of behaviour especially in busy

streets in urban areas can prove to be fatal for the listener. For instance, it might even not always be a head-on collision with a vehicle. One such incident occurred in 2016 when a cyclist using headphones [4] entered a roundabout and suddenly noticed a vehicle exiting the roundabout at the same time. Even though no collision occurred, the victim who was thought to be distracted and listening to music panicked at the sudden sight of the vehicle and fell from the cycle to the sidewalk, fracturing her skull and spinal cord on the spot.

When it comes to identifying warning signals for potential danger, the eyes and ears are the most important sensory organs of the human body. There is a much higher chance of a pedestrian wearing headphones facing an accident rather than a person who is not, since such a person will not be able to receive any auditory input of incoming vehicles. Studies have shown that there has been some sort of warning or indication of such an incident been about to occur before most pedestrian fatalities take place. A pedestrian who is not using headphones would have a higher chance of hearing an approaching vehicle, the noise of brakes being applied or the honks from a car. Meanwhile, headphone users might not hear or even see any of these danger cues due to unintentional blindness caused by a sensory overload.

Smartphones play a major role in a person’s life today, be it for entertainment, education or business purposes. Many smartphone users also wear headphones for ease of communication and relaxation especially while traveling. As Fig. 1 depicts, the use of headphones or earphones have increased drastically within the last few years and studies indicate it will only increase further with the new improvements being made to them using modern technologies [5].

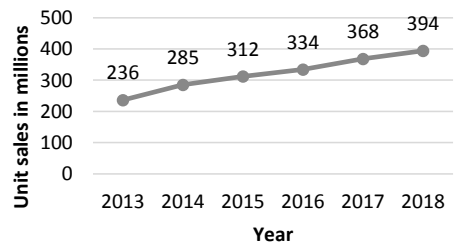


Fig. 1 Global unit sales of headphones

(Source: <https://www.statista.com/statistics/327000/worldwide-sales-headphones-headsets/>)

Although the usage of headphones keeps on increasing by a large scale each and every year, as shown in Fig. 2 the main purpose of headphones or earphones is still entertainment i.e. to listen to music [6].

The results of a study conducted in China and USA in 2016 among teens and pre-teens regarding distracted walking resulted in 39% of the individuals being distracted due to headphones in the USA and 42% in China [7] [8].

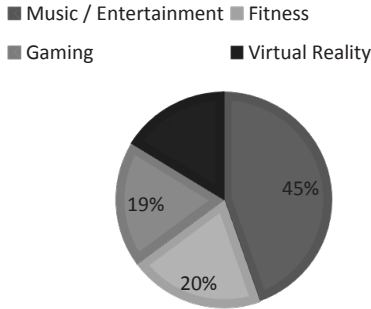


Fig. 2 Headphone Usage in 2019

(Source: <https://www.grandviewresearch.com/industry-analysis/earphone-and-headphone-market>)

Wearing a pair of headphones will automatically cut off about 15 to 20 decibels of surrounding noise from the listener’s ears. An additional noise reduction of around 20 decibels is provided by present-day headphones and data gathered by leading companies in the audio industry prove that most individuals prefer to utilize headphones with these capabilities over normal ones. While these properties such as noise cancellation, custom fitting and in-ear headphones are immensely beneficial for most users in noisy environments, it can lead to devastating repercussions for a pedestrian on a busy road. In the majority of such cases, a warning noise was heard beforehand [9]. Especially in the cases of train accidents where trains have been known to repeatedly blast their horns in order to warn the pedestrians but have been ineffectual.

Although many smart headphones nowadays are equipped with a great list of advanced features such as [10] language translation, audio enhancement, fitness tracking and personal assistants, none of them have been developed to ensure a pedestrian’s, cyclist’s or jogger’s safety when travelling on the road.

A research conducted in 2019 by Audio Analytic, an Artificial Intelligence company focused on sound recognition shows that over the last year, 37 million Americans felt that they were more exposed to danger when wearing headphones or earphones while walking, jogging or cycling [11].

II. RESEARCH QUESTIONS

1. Do the use of headphones by pedestrians lead to an increase in road accidents?
2. How do noise cancellation features in headphones contribute to this factor?

3. Can an effective solution be implemented to resolve the issue?

III. METHODOLOGY

This research was conducted using primary data and quantitative secondary data. Firstly, a study was conducted to analyse data gathered from major companies which manufacture the most in demand headphones with noise isolating attributes. The amount of background noise cut off by each headphone was analysed and compared. In addition, an alternate experiment was conducted to measure the sound intensity of car honks and clarify whether headphones users would be able to hear them in a fairly busy street environment. During the process of data collection and analysis in both studies, the unit of measurement, decibels, was applied to measure sound intensity and the degree of loudness.

IV. RESULTS

Noise isolation through headphones can be classified into two categories, passive isolation and active noise cancellation. Passive isolation is the noise suppression which occurs due to the physical design of the earbuds or the material of the headphones while active noise cancellation occurs from the scientific technology that is used to neutralize the sounds which infiltrate the headphones.

A. Noise Isolation Analysis

Data was gathered to calculate the mean noise isolation for bass, mid and treble ranges separately for five headphones, each from different brands which had the highest ratings for the best noise cancellation features [12]. All statistics and data applied in the study were based on headphones of the over-ear type with closed-back enclosure. The overall noise isolation produced was calculated from these three ranges. Fig. 3 illustrates the results of the study.

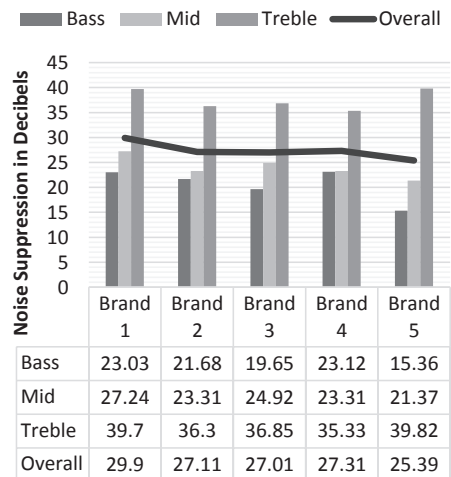


Fig. 3 Noise Isolation in Headphones

The lowest mean noise suppression belonged to the bass-range category at 20.56 decibels. The treble-range had the highest suppression level of 37.60 decibels. Meanwhile, the mid-range had a suppression of 24.03 decibels. Hence, the overall mean noise cancellation produced by a pair of headphones was computed as 27.4 decibels.

B. Sound Intensity Level

A similar study was conducted to measure the noise level made by a vehicle horn at fixed distances. The environment setting of a moderately busy street was stimulated to obtain the best results. The sound was measured using a noise meter app with pre-calibrated measurements to assess the sound pressure level.

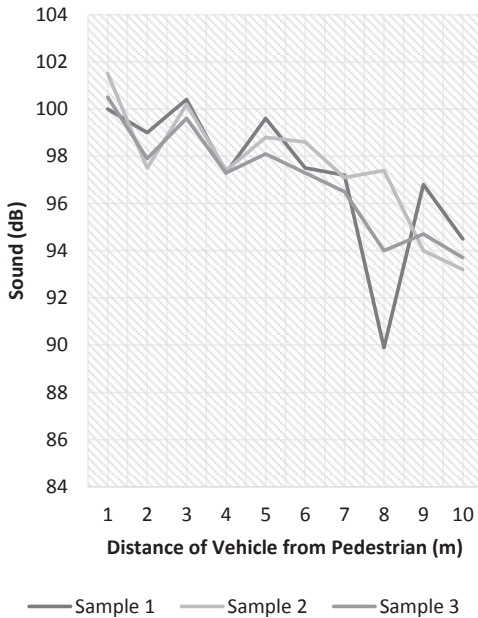


Fig. 4 Sound Intensity of a Car Horn

The tests were performed thrice to achieve the highest possible accuracy level. The vehicle horn was sounded for an average of 3 seconds, but anomalies are visible at certain points in the graph represented in Fig. 4 when this time limit was either incremented or decremented. It could be observed clearly that the intensity increases swiftly the longer the horn is sounded.

TABLE 1
AVERAGE NOISE INTENSITY OF A HONK

Distance (m)	Noise Level (dB)
1	100.5
2	97.9
3	99.6
4	97.3
5	98.1
6	97.3
7	96.5
8	94.0

According to the results of the above experiment, the average sound intensity of a car horn is highest when the pedestrian is away from the vehicle by 1 metre. As shown in Table 1, the intensity gradually decreases as the pedestrian moves further away from the vehicle but still remains above 90 decibels. The average intensity varies from vehicle to vehicle especially since horns used by heavy vehicles have a much larger intensity than of others. The data in the above experiment was gathered from a car horn since cars are considered to be the most popularly used vehicles in the world.

V. DISCUSSION

When comparing the results of the first study of analysing noise isolation properties of headphones and earphones with the results of the car horn sound intensity experiment, it can be observed that there is a very low chance of a pedestrian wearing headphones hearing a noise before an accident is about to occur. The pedestrian might be having ‘inattentive blindness’, especially if he or she is listening to music at a high-volume level. Inattentive blindness is the inability to notice various objects or events when one’s attention is directed elsewhere [13].

A possible solution to overcome this issue would be to develop smart headphones with the technology to alert the wearer of any forewarnings regarding danger using embedded systems. Miniature microphones added to the headset externally could be able to record the noises in the headphone-wearer’s environment. The microphones should be placed in such a manner that the noise detected will be balanced on both left and right sides of the headphone. Depending upon the direction of the approaching vehicle or any such imminent danger, the headphone should be equipped to alert the user with a beep or a signal on that specific side of the ear (either left or right). Sensors could also be used to estimate the distance between the pedestrian and an incoming vehicle [16]. The microphones which are situated externally on the pair of headphones will be able to transfer the data to be analysed in real-time. Since almost all pedestrian headphone-wearers, cyclists or joggers use a headphone with the assistance of a smartphone, it would be convenient for the user to have an installable app which can be used to display more information regarding his or her environment. The app can be used to keep the user constantly aware of his or her surroundings. It should also be kept in mind that the solution should be implemented in a cost-effective and user-friendly manner.

As the results of the experiment on car horn intensity demonstrate, it is much more feasible and easier to detect vehicle honks rather than detecting car tire or engine sounds. Even in a busy street environment, car honks can be heard clearly over other noises. Since a noise cancellation of 27.4 decibels is provided by an average pair of headphones, any noises the pedestrian should be able to hear will be clouded or simply unheard. The perception-reaction time of a driver responding to the unexpected sight of a pedestrian in front of the vehicle is of a duration ranging between 2 and 5 seconds [14]. Meanwhile, the median reaction time for a pedestrian is 0.3 seconds [15]. Even though the reaction speed of a normal pedestrian is quite high, there will be a substantial delay in this speed when it comes to a pedestrian wearing headphones. Past research indicates that the sudden reactions of a driver in a

vehicle travelling at a high speed will result in the driver losing control of the vehicle and he or she will most likely be overapplying the brakes. The after-effect usually produces a noise such as the screeching sound of the brakes. A normal bystander would hear such noises even before seeing the vehicle which will in turn provide them a longer time limit to secure themselves. It will not be the case for a pedestrian wearing headphones, especially if his or her back is turned to the vehicle.

VI. CONCLUSION

In conclusion, modifications must be implemented in headphones in order to resolve this issue so that pedestrians will be able to use them without been in constant danger.

The outcome of this research indicates that pedestrians, joggers and cyclists who utilise headphones while they are on the road, are in more danger of facing a road traffic accident rather than a normal pedestrian. Being able to hear a vehicle horn can actually make the difference between life and death for a person.

The studies conducted in this research prove that the noise suppressing features of present-day headphones contribute to reducing the auditory senses of pedestrians. With the revenue generated by the sale of smart headphones increasing rapidly each year, it would be a smart move to develop headphones which aid in the listener's safety, especially with the modern technological concepts been used in headphones today.

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An Evaluation of Performance of Teacher Trainees in Initial Teacher Education: A Case Study

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Abstract - Privatization and internationalization of education in Sri Lanka has created a demand for more trained teachers, unlocked teacher education to private teacher training institutes in Sri Lanka. To maintain the quality of the programme, tertiary authority registration of the relevant programme is required for the institute. Objectives of the study are to assess the current levels of performance of the trainee teachers, to investigate the challenges and issues faced by the institute and to examine the impact of the tertiary authority registration process on Teacher Education Diplomas. The sample size of this qualitative/quantitative research is 90 teacher trainees. Data collection methods were questionnaire, key informant interviews and documentary analysis. Study found that 63% trainees believed their performance is very good while 29% and 8% believed their performance is good and averaged respectively. However, there is no significant relationship between education and performance. Although the tertiary authority uses online platforms, the findings of the study revealed that the institute faces constant challenges due to procrastination practices and bureaucratic procedures. Furthermore, the institute struggles with the supervision of teaching practice. 87% trainees stated that registration of their diploma at the tertiary authority motivated them to enroll at the institute, yet the registration of the diplomas at the tertiary authority had on low impact on the learning teaching process.

Key Words: *Performance, Tertiary authority, Teacher education, Teacher trainees*

I. INTRODUCTION

Teaching is the noblest profession and they transform students' behaviour with knowledge attitudes and skills. On the other hand, students' performance depends on teachers' performance. Therefore, teacher education is very vital since the teachers mould the future generation. Rahaman et al (2011) stated that "teacher education is the integral part of the education system, has greatly expanded and will expand further to cater to the fast emerging needs of the country" (p.150). According to United Nations Educational, Scientific and Cultural Organization (UNESCO), Teacher Education is formal training for teachers who can be in pre-service or in service and which is intended to furnish them with knowledge, attitude, behaviour and skills requisite for teaching at the relevant level. There is a formal Teacher Education system in Sri Lanka specifically with reference to Government higher education policy. State sector teacher education starts at G.C.E Advanced Level or at National

College of Education or University level. However, presently privatization of education is inevitable. Noticeably, this has an impact on teacher education as well and there is increasing number of private higher education institutes who conduct Teacher Education diplomas. Higher education institutes at present concentrate more on Teacher Education at tertiary and vocational level which will lead to employment or job opportunities. According to Edirisinghe (2016) tertiary and vocational training helps trainees acquire skills and prepare them for employment. Tertiary education can be defined as third level or post secondary education after completion of secondary education at school and this consists of academic and vocational education. In order to obtain the state recognition, the higher education institutes need to be registered in Tertiary Vocational and Education Commission (TVEC) in Sri Lanka. Conversely, without TVEC registration neither relevant institute nor Teacher Education diploma will be recognized by the students, their parents and all other relevant stakeholders. TVEC maintains the nationally recognized policy for awarding TVEC certificates and development and maintenance of academic and training standards for institutes, agencies and all other Tertiary Vocational and Education Training (TVET) providers (Ministry of Skills Development and Vocational Training 2019).

This study is carried out in one of the well-known Higher Education Institute/Non-state universities in Sri Lanka. However, in order to achieve the research objectives headquarters of the institute will be considered and the effectiveness of teacher education diplomas which are registered under the TVEC are focused here. Effects of the registration of TVEC on the teacher education diplomas, current procedures are also discussed.

B. PROBLEM STATEMENT

Due to privatization and internationalization of education in Sri Lanka, it demands more trained teachers. Limited numbers of teacher trainees are recruited in State teacher training colleges or National College of Education with all three qualified subjects in Advanced level examination. Therefore, the need or the opportunity has been unlocked for privately owned teacher training academies or institutes. Wettawa (2016) claimed that Sri Lanka identifies private education as a crucial driver for economic growth and option as a fundamental element of democracy. Hence, there are teacher education programmes booming in higher education sector. In order to maintain the quality, the higher education institutes should register their organization and programmes with the TVEC and maintain the

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entry level qualification for teacher trainees or prospective teachers. Nevertheless, in order to achieve the business objectives higher education institutes, need to attract more trainees therefore, like any other private institute ABC Higher Education Institute also maintains their flexible registration process specifically with regards to entry qualification of teacher trainee which will impact on quality of the teacher education. More often than not the institute is stressed to comply with three passes in Advanced level examination as a minimum entry qualification for teacher trainees. However, occasionally the institute is unable to comply with the at least two passes of Advanced level qualification since they must achieve the business objectives. According to Wheelahan (2014) qualifications for Vocational and Tertiary level teacher trainees could be varied depending on the level at which they are teaching. This means there is no consistency in their entry level qualification. Not only entry qualifications but also there are issues pertaining to teaching practice and supervision since there is no proper evaluation mechanism. According to Edirisinghe et al (2016), in fact, there is a lack of monitoring, evaluation and coordination system for TVET sector. Further institution entertains or at times struggles with the needs of the students including lame excuses especially in relation to teaching practice. Ultimately, these issues will lead to the quality of prospective teachers.

There were some studies carried out in relation to Teacher Education in Sri Lanka with reference to state sector, Polgampala (2020) Lekamge (2018), National Education Commission (2016), Nanayakkara et al (2006), Johnson (2006) Dharmadasa et al (1996), Totto et al (1993), Wewegama (n.d.). However no or least possible researches have been done in connection with Teacher Education in private institutes and TVEC registration pertaining to the said programmes. Hence, the researcher intends to find out levels of current performance of the trainee teachers and impact of TVEC registration process on Teacher Education diplomas since teachers act as a change agent and immensely contribute to the education system and high-quality workforce.

A. SIGNIFICANCE OF THE STUDY

The study intends to enhance the existing knowledge in the subject area of Teacher Education system. Though there is ample number of researches on the Teacher Education, there are only few researches in the Sri Lankan context. Further, even there are very few researches has been done particularly with regards to teacher education in privately owned Higher Education Institutes. Less researches have been conducted in Teacher Education and Non state universities in Sri Lanka. Therefore, current study realizes the empirical gap in the Sri Lankan context.

Previous studies have concerned more on identifying Teacher Education in State sector rather than the private sector. Throughout this study the research gap will be addressed as this is the study to assess the performance of teacher trainees and examine the impact of TVEC registration process on Teacher Education Diplomas in privately owned higher education

institutes which can not be ignored as the privatization of education is unavoidable now. Moreover, research studies and textbooks on teacher education are not extensive. Therefore, this study will be a helpful reading material for students and researchers. The findings of this research will be of assistance to the future researchers to conduct their researches more successfully.

The findings of the study will help for the management of higher education institutes to formalize their registration process particularly with regards to entry qualifications, evaluation and monitoring of teaching practice, better coordination with TVEC and attract more trainee teachers and ultimately improve the quality of Teacher Education in private institutes.

C. RESEARCH QUESTIONS

1. What are the levels of current performance of the trainee teacher?
2. What are the challenges and issue faced by the institute in registration process?
3. What is the impact of the TVEC registration process on Teacher Education Diplomas?

D. OBJECTIVES OF THE STUDY

1. To assess the current levels performance of the trainee teacher.
2. To investigate the challenges and issue faced by the institute in registration process.
3. To examine the impact of the TVEC registration process on Teacher Education Diplomas.

II. DATA AND METHODOLOGY

The study can be considered as a survey research and quantitative data has been complemented with the qualitative data in the study. Simple random sample used to select the respondents. Population of Teacher trainees were 105 and the researcher has used random number method by assigned every teacher trainee a number and sample size of 90 randomly selected a subset of the population. Biographic details of the teacher trainees are their age range varied from 19 to 35 years old and they represent different areas of the county. Further their educational background differs from G.C.E. Advanced Level qualification to degree level. Data collection methods were questionnaire, key informant interviews and documentary analysis. Area of the study is one of the largest Higher Education Institutes which is also recognized as a one of the well-known non- state universities in Sri Lanka. Questionnaire consists of main sections on demographic characteristics, performance of the respondents.

Performances of the teacher trainees have measured according to the 5-point Likert scale. For the purpose of gathering data three key informant interviews have conducted with key stakeholders in the organization viz with the Head of the Department and Coordinator of the programme. Analysis of documents, informal discussions and secondary data has been used to collect more information. Secondary information is

readily available information to use for the research. Therefore, relevant reports and documents in the institute, newspapers, articles, gazette, and minutes of meetings, internet and intranet have taken as secondary data. Response rate is hundred percent and Saunders et al suggested (2007 as cited in Jocelyne 2014) that the response rate of at least 90 per cent was considered as good rate.

III. RESULTS

According to the findings of the study, 69% teacher trainees are female compared to male (31%) trainees (figure 1). Majority of teacher trainees (55%) are between age ranges of 18 to 23 years, 25% of teacher trainees are age range of 24 -29, 11% teacher trainees are 30 -35 of age range, 5% of teacher trainees are age range of 36 -41 (Figure 2). Study revealed the qualification levels of teacher trainees, namely, 69% teacher trainees are Advanced Level partly or fully qualified, 26% diploma qualified, 1% degree qualified and 4% Ordinary Level qualified (Figure 3). Thus 63% trainees believed their performance is very good while 29% and 8% believed their performance is good and average respectively.

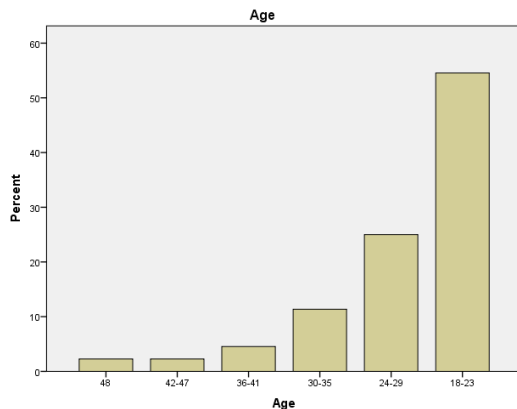


Figure 2: Age ranges of teacher trainees

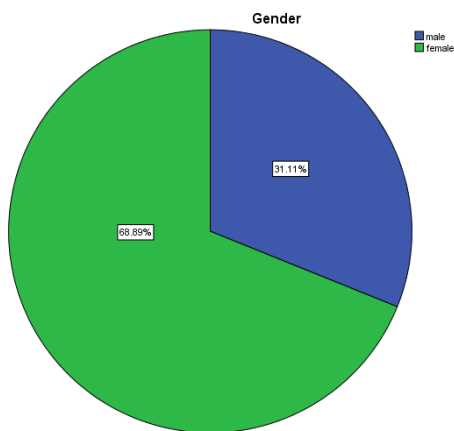


Figure 1: Gender Analysis

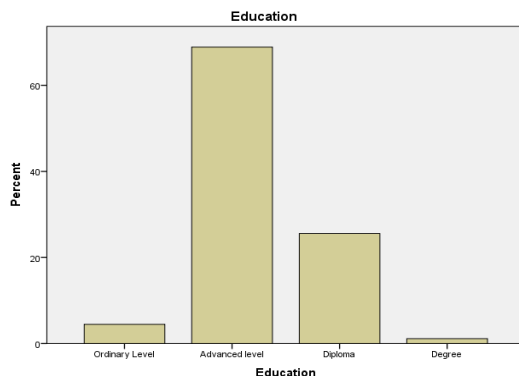


Figure 3 : Education levels

However, there is no significant relationship between education and performance. Although the tertiary authority uses online platforms, the findings of the study revealed that the institute faces constant challenges due to procrastination practices and bureaucratic procedures. Furthermore, institute struggles with the supervision of teaching practice.

Study discovered that 38% trainees mentioned learning teaching process to be improved by regular evaluation while 22% said they need revision and 11% stated need to use multimedia frequently.

IV. CONCLUSION

The study concluded that there are more female teacher trainees compared male and their performance is in good level though 38% trainees emphasized that performance can be improved

through regular evaluation. 87% trainees stated that registration of their diploma at the tertiary authority motivated them to enroll at the institute though the impact of the said authority low on learning teaching process of Teacher Education diplomas.

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Assessing the Determinants Affect for Hambantota District Public Transportation Users when Selecting a Travel Route [A Contemporary Survey Based on Southern Expressway (E001) and Normal Route (A02)]

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Abstract— This study has focused to identify the factors effects to Hambantota district public transportation users when selecting travel route. Principally the travel experience on Southern expressway (E01) and normal route Colombo-Hambantota (A02) journeys are considered in this study. It provides a framework for understanding the passenger satisfaction levels and then the requirements while travelling from Southern province to Western province by using expressway and normal route. An exploratory factor analysis was carried out using 09 independent variables for both expressway and normal route journey. It was concluded with 03 factors for route journey: (Nature of Travel, Passenger requirement and Convenience of travel) and 04 factors: (Passenger requirement, Convenience of Travel, Operational Factors and Passenger Expectation) for the expressway journey, which determined the perception of commuters. Amongst, the nature of travel and the passenger requirements were having a correlation for the passenger satisfaction of normal route journey, besides, operational factors having a correlation towards the journey satisfaction

Keywords— *Expressway, Factor Analysis, Passenger Satisfaction, Public Transportation*

I. INTRODUCTION

A. Background of the Study

Presently transportation plays a vital role in the development of a country in terms of every aspect, henceforth it is essential to have an improved, faster, efficient and economical transport network.

The historical development of the road network in Sri Lanka dates to the colonial eras, primarily when roads were constructed to transport agricultural products of Tea and Coffee from plantation areas in the hill countries to the port of Colombo and were used for civil administration and defence. At the status, it is divided into three categories: National Roads, Provincial Roads and roads governed by Local Authorities, being SLRDA (Sri Lanka Road Development Authority) the responsible arm. The National Road Network consists of 12,210.36 km of Trunk (A class) and Main (B class) roads and about 4,662 bridges that span of more than 3m.

The Southern Expressway (E001) is the 1st Expressway experience for Sri Lanka, proceeding with Outer-Circular Highway (E002) and Colombo – Katunayeka Expressway (E003) that totally accounts for 169.845 km. This contemporary study focuses on the ongoing Extension of the Southern Expressway Project (ESEP) from Matara to Hambantota under 04 sections: Matara to Beliatta, Beliatta to Wetiya, Wetiya to Andarawewa and Hambantota to Mattala via Andaraweva.

II. LITERATURE SURVEY

D. Public Transportation

If transport is known as a facilitator to the economy, public transportation plays a major role in maximizing productivity and the competitiveness. Economic benefits of public transport can be divided into 03 main parts: Efficient connectivity between labour to the marketplace, helps to reduce productivity bottlenecks and maximize the opportunity for individuals and businesses. Public transportation helps to achieve economic connectivity between major trade centres also provides social cohesion between diverse demographics in societies.

In every country expressway encourages the volumes of traffic when traffic congestion is high. But to move for public transportation, attractive transport facilities should be provided to passengers. Public transportation creates a lot of advantages to the passengers and as a socio-economic factor, to uplift the quality of life of the citizens.

E. Customer Satisfaction on Bus Transportation

Customer satisfaction has been identified one of the major drivers in revenue generation of public/private passenger transportation sector. Studies with similar panoramas have taken as guidance to develop the variables which has used in research. The main variables have categorized under waiting time, accessibility, charges, safety, and security, driving aids for safe driving, service quality.

Passengers who spend longer waiting time, it will also tend to be more stressed. Long wait times are caused due to services not running according to flexible time schedule, which, in turn, induces stress due to lack of insufficient capacity and crowding are the major causes of stress among commuters. (Olio, Ibeas, & Cecin, 2011). A case study (2000) has recommended operating the newly built expressways as controlled access expressway with optimum road condition (Dandekar & Mahajan, 2001) In the study, it has been indicated expressway charges as a factor finding effected to the customer satisfaction (Limited, Limlight, 2012) Himachal Pradesh Road and Other Infrastructure Development Corporation Ltd (HPRIDC) (2007) has diagnoses the key factors affection road users' satisfaction in their survey and the safety had included as a key factor that effect the customer satisfaction. A study on National Road Users Satisfaction Survey has stated that "Higher proportions had been aware of road network's in advance of their trip (65% compared with just 54% in 2011/12) with more findings out via road signs" (Alkaabi, 2014). In the empirical study carried on "customer satisfaction measurement within the road sector" by (Shaaban & Khalil, 2013) has stated that the service level quality had been a major influence in customer perception on road networks.

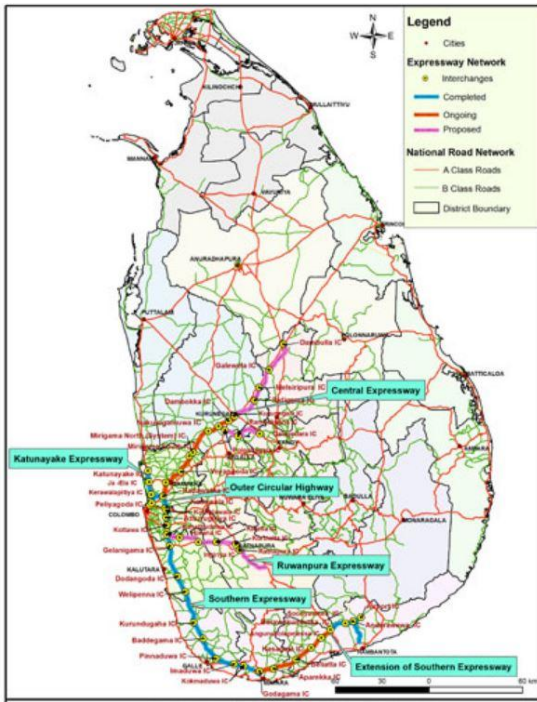


Fig. 1 Expressway Network in Sri Lanka
Source: Sri Lanka Road Development Authority

B. Significance and Aim of the Study

People in Hambantota must come to Matara to get an expressway bus starts from Matara, either travel from Hambantota to Colombo using Trunk road (A02) / normal route, which takes approximately additional 2.5 hours per trip. Thus, the research aims to study and assess the factors affect for users when selecting a travel route from ESEP and A02. Findings of the study are critical when influencing authorities to improve the services to attract more passengers, to increase income of the expressways, to improve the quality of transportation service in the country by addressing customer demands and finally to expand the capacities of convenience.

C. Objectives of the Study

The objective of the research is to:

- Assess the determinants affect for passenger satisfaction level from expressway journey and normal route journey.

III. METHODOLOGY AND EXPERIMENTAL DESIGN

F. Population and Sample

The target population was considered as commuters in Hambantota district and to extract the sample, it is used: Simple Random Sampling (SRS). The most applicable data type was categorical data that had being obtained through a structured questionnaire. The questionnaire was distributed: web based and the printed form. The basic objective of the questionnaire was to identify the factors which are considered when selecting the travel route either expressway of normal route. Respondents were given the chance to reflect their experiences after completing the questionnaire.

G. Identified Variables and Questionnaire

The dependent variables are identified as the level of satisfaction on expressway journey (E001) and normal route journey (A02) of public transportation users'. The independent variable for the normal route journey were identified as: Travel time, Ticket price, Connectivity, Punctuality, Comfortability, Traffic density, Safe driving, Bus speed, Frequency of operation, Passenger crowd, Mobility, passenger queue length, Cleanliness (Interior/Exterior), Bus brand, Adequate space on board, Travel schedule flexibility, Distance from origin to entrance, Distance from exit to destination. And the independent variables for the Expressway journey was identified as Travel time, Mobility, Traffic density, Passenger queue length, Bus speed, Seat comfortability, Cleanliness (Interior/Exterior), Safe driving, Bus brand, Adequate space on board, Bus availability rate, Travel schedule flexibility, Distance from origin to entrance, Distance from exit to destination and Ticket price.

The questionnaire was designed in three sections: Part A: to collect the demographic factors and passenger travel purpose, part B: to collect data related to passenger perception on Colombo-Hambantota normal route bus journey, part C: to collect data related to the passenger perception on Colombo-Hambantota Southern Expressway public bus journey. The five-point Likert scale is used in questionnaire preparation.

H. Data Collection and Analysis

The structured questionnaire was distributed among 237 respondents in Google form & printed format and collected the primary data. Secondary data were used mainly for conceptualization of the study. Data collected from various sources: journals, literature books, articles, conference papers, magazines, thesis papers, research papers. The collected primary and secondary data was analysed using SPSS (Statistical Package for Social Sciences)16.

I. Justification to the Theoretical Framework

The data analysis methods used for the study are: Cronbach's Alpha test to test the reliability, Kaiser-Meyer-Olkin value (KMO) has applied to test the adequateness of the sampling test to run a factor analysis Bartlett's statistics test has applied to the test the homogeneity of variance, descriptive statistics was used to explain the demographic factors, Factors extraction is explained using principal component analysis, Factor rotation is explained using varimax method and Factor scores are explained using regression method.

IV. DISCUSSION OF RESULTS

A. Demographic Analysis of Participants for the Normal Route Journey

Initially out of the respondents from the Hambantota district majority (51.1%) were males, and females accounted for the remained percentage. Considering the age factor, 44.3% of the respondents fallen under 15-25 years. It was also observed that there was comparatively a higher percentage (28.3%) of respondents from people within the age group of 26 to 35 years. According to the highest education level achieved, 56.1% of the respondents have studied up to Advanced Level which accounts for the majority and the minority of 1.7% having a master's degree. According to the current employment factor, 51.1% are currently employed which accounts for the majority and only 3.4% of the respondents were unemployed. The factor of monthly income was distributed with the majority of 40.1% of the respondents earning an income less than that of 25,000.00 LKR per month and 76% of the respondents are having an income of less than 50,000.00 LKR per month which depicts higher number of people living in average income conditions. When considering the factors of frequency of travel and commuting purpose, 59.5% of the commuter respondents travel occasionally, amongst majority visits their family /relatives. Only 11.5% of the commuters visits at a high frequency (monthly or weekly basis) while a least percentage (0.4%) of them travel for leisure purpose.

B. Analysis of the Variables in Normal Route Journey

The variables considered for the normal route journey consists of 10 independent variable and the Cronbach's alpha value of which at the initial stage were 0.813. If deleted the variable "ticket price on normal route journey" the alpha value can be increased up to 0.820 and to get maximum internal consistency between variables, ticket price of normal route journey has not been considered further.

The value of KMO Measure of Sampling Adequacy depicts 0.799 which is greater than that of 0.5, and it is evident that it is capable of analysing through 'exploratory factor analysis'.

Bartlett's test hypothesis:

H₀: Correlation matrix is an identity matrix

H₁: Correlation matrix is not an identity matrix

Since P-value (0.000) is less than that of the critical value $\alpha = 0.5$, the test statistics is significant and reject H_0 . It can be concluded with 95% confidence that there is an association between variables, hence suitable for the factor analysis.

Safe driving	1.000	.556
Traffic density	1.000	.788
Passenger crowd	1.000	.628

C. Frequency Analysis for the Satisfaction Level

Respondents who commuted using public transport in the normal route were questioned on their views regarding certain aspects on normal route journey, punctuality, connectivity, travel time, frequency of operation, bus speed, safe driving, traffic density and passenger crowd. According to the analysis minimum number of respondents, (below 2%) are to be strongly satisfied, with the highest response for strongly satisfied respondents being 1.7% for connectivity, bus speed and safe driving. It can be observed that more respondents (18.6%) were strongly dissatisfied with the passenger crowd of normal route public transport than other factors. However, safe driving of mode and traffic density on normal route were with 12.2% and 11.0% of respondents stating respectively to be strongly dissatisfied with both those factors. When assessing the factors; connectivity, frequency of operation, bus speed, safe driving, traffic density and passenger crowd of normal route public transportation separately, majority of the respondents (43.0%, 49.8%, 44.7%, 43.0%, 43.9% and 40.5% respectively) reacted as neutral. However, when it came to punctuality, travel time, and comfortability higher number of responses (42.2%, 54.9%, and 59.1% respectively) were dissatisfied by these factors regarding normal route public transport journey. Hence, it can be concluded that most of the respondents either felt neutral or dissatisfied by the above-mentioned aspects of the normal route journey.

D. Descriptive Statistics Analysis of Dependent Variables

According to descriptive statistics, the highest mean is 3.69 which is for comfortability and passenger crowd while lowest mean is for the frequency of operation which is 3.27. Since, all variable values are with the range of 3-4 in Likert scale, it proves that majority of people are neutral and dissatisfied for the normal route journey. The standard deviation values depict 0.942 at the maximum for safe driving.

TABLE 1
COMMUNALITY TABLE FOR NORMAL ROUTE PUBLIC TRANSPORT

Variable	Initial	Extraction
Punctuality	1.000	.764
Connectivity	1.000	.752
Travel time	1.000	.519
Frequency of operation	1.000	.597
Bus speed	1.000	.743
Comfortability	1.000	.734

According to table 1, 78.8% of variance of traffic density is explain in this model as the highest while, 51.9% of travel time is explained as the lowest in this factor analysis.

E. Factor Analysis

TABLE 2
TOTAL VARIANCE

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	3.750	41.667	41.667
2	1.282	14.244	55.911
3	1.048	11.642	67.553
4	.763	8.478	76.031
5	.565	6.283	82.314
6	.501	5.571	87.886
7	.406	4.506	92.392
8	.371	4.127	96.519
9	.313	3.481	100.000

adjusted

According to table 2, and considering the initial Eigenvalues there are 03 factors extracted representing a cumulative model variance of 67.55%. This further demonstrates with the scree plot depicted in fig. 2.

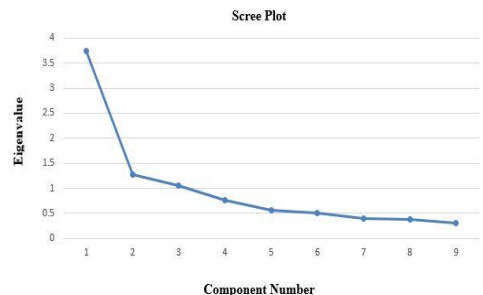


Fig. 2 Scree Plot-Normal Route Public Transport

According to the rotated component matrix and the component score coefficient matrix, the following results obtained:

Factor 01 includes 03 variables and collectively defined as “Nature of travel – F(x)”.

- I. Safe driving - a
- II. Traffic density - b
- III. Passenger crowd - c

Factor 02 includes 03 variables and collectively defined as “Passenger requirement – F(y)”.

- I. Frequency of operation - d
- II. Bus speed - e
- III. Comfortability - f

Factor 03 includes 03 variables and collectively defined as “Convenience of Travel – F(z)”.

- I. Punctuality - g
- II. Connectivity - h
- III. Travel time - i

Thus, it is evident that the perception of using normal route depends on nature of travel, passenger requirement and convenience of travel, with below coefficients.

$$F(x) = (0.361) a + (0.505) b + (0.411) c$$

$$F(y) = (0.393) d + (0.521) e + (0.397) f$$

$$F(z) = (0.533) g + (0.586) h + (0.244) i$$

F. Pearson Correlation Coefficient for Extracted Factors

H₀: There is no correlation between the ith factor and the satisfaction level on normal route public transport journey

H₁: There is a correlation between the ith factor and the satisfaction level on normal route public transport journey (i = 1 - Nature of Travel, i = 2 – Passenger requirement, i = 3 – Convenience of travel)

Accordingly, the values significantly depict that there is a correlation between the nature of travel and passenger requirements with the satisfaction level of normal route journey, and there is no correlation between convenience of travel against the satisfaction level.

G. Demographic Analysis for Expressway Public Transport Journey

97% of the respondents were currently using the expressway for their transportation purposes and 98% of the respondents illustrated the willingness to complete their journey using expressways. The highest (46.8% and 40.9%) percentage of respondents could reach their destination within 2hrs to 2½hrs and 1½hrs to 2hrs respectively. It is evident that passengers will be able to reduce their travel time in a significant amount. According to the satisfaction level of expressway bus fare, 97% of the respondents were willing to pay 500-1500 LKR for the expressway public transport journey. According to the respondents, the facilities required for the expressway journey has mentioned with a higher

percentage as: air conditions, seat reservation facilities and, sanitary facilities in the terminals.

H. Analysis of the Variables in Normal Route Journey

The variables considered for the normal route journey consists of 15 independent variable and the Cronbach’s alpha value of which at the initial stage were 0.849. If deleted the variable “ticket price on expressway journey” the alpha value can be increased up to 0.852 and to get maximum internal consistency between variables, ticket price of expressway journey has not been considered further.

The value of KMO Measure of Sampling Adequacy depicts 0.766 which is greater than that of 0.5, and it is evident that it is capable of analysing through ‘exploratory factor analysis’.

Bartlett’s test hypothesis:

H₀: Correlation matrix is an identity matrix

H₁: Correlation matrix is not an identity matrix

Since P-value (0.000) is less than that of the critical value $\alpha = 0.5$, the test statistics is significant and reject H₀. It can be concluded with 95% confidence that there is an association between variables, hence suitable for the factor analysis.

I. Frequency Analysis for the Satisfaction Level

Respondents who were willing to use the Southern Expressway public transport were questioned and depicts the importance of these factors in relations to expressway public transportation. It can be observed that more respondents (84.4%) mentioned travel time is very important when selecting Expressway public transportation. Apart, they mentioned seat comfortability, cleanliness (interior/exterior), safe driving (53.6%, 59.1% and 69.6% percentages respectively) as the most important factors when selecting Expressway public transportation. Very few of respondents mentioned, any of these factors were not important.

When assessing the factors; mobility, traffic density, passenger queue length, bus speed, bus brand, adequate space on board, bus availability rate, travel schedule flexibility, distance from origin to entrance and distance from exit to destination separately, majority of respondents (45.6%, 57.0%, 59.5%, 46.8%, 33.8%, 46.0%, 38.0%, 42.2%, 43.9%, 42.6% respectively) mentioned as important factors when selecting Expressway public transportation. Significantly 37.1% and 39.2% of respondents were neutral with the importance of distance from origin to entrance and distance from exit destination respectively. Thus, it can be concluded that most of respondents consider these factors either very important or important when selecting Expressway public transportation.

J. Descriptive Statistics Analysis of Dependent Variables

According to descriptive statistics, all variable lies between the range of 3-5 in Likert scale, this also proves that most of

the respondents have mentioned that these factors are either very important or important when travelling in expressway.

TABLE 3
COMMUNALITY TABLE FOR EXPRESSWAY PUBLIC TRANSPORT

Variable	Initial	Extraction
Travel time	1.000	.372
Mobility	1.000	.608
Traffic density	1.000	.736
Passenger queue length	1.000	.639
Bus speed	1.000	.660
Seat comfortability	1.000	.798
Interior/Exterior cleanliness	1.000	.761
Safe driving	1.000	.716
Bus brand	1.000	.588
Adequate space on board	1.000	.789
Bus availability rate	1.000	.720
Travel schedule flexibility	1.000	.661
Distance from origin to expressway entrance	1.000	.747
Distance from expressway exit to destination	1.000	.685

According to the table 3, 79.8% of variance of ‘seat comfortability’ is explain in this model as the highest while, 37.2% of travel time is explained as the lowest values.

K. Factor Analysis

TABLE 4
TOTAL VARIANCE

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	4.943	35.304	35.304
2	1.863	13.308	48.613
3	1.657	11.833	60.446
4	1.018	7.268	67.714
5	.912	6.517	74.231
6	.798	5.698	79.928
7	.678	4.845	84.773
8	.430	3.073	87.846
9	.397	2.833	90.679
10	.384	2.745	93.423
11	.326	2.329	95.753
12	.246	1.755	97.508
13	.189	1.350	98.858
14	.160	1.142	100.00

According to table 4, and considering the initial Eigenvalues there are 04 factors extracted representing a cumulative

model variance of 67.71%. This further demonstrates with the scree plot depicted in figure 3.

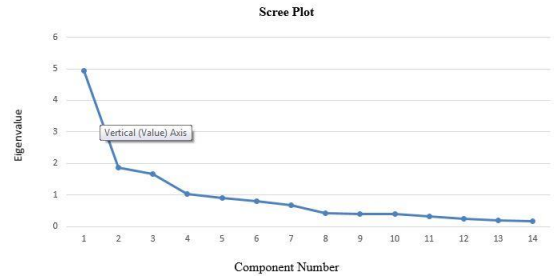


Fig. 3 Scree Plot-Expressway Journey

According to the rotated component matrix and the component score coefficient matrix, the following results obtained:

Factor 01 includes 04 variables and collectively defined as “Passenger requirement – F(a)”.

- I. Bus speed - j
- II. Seat comfortability - k
- III. Interior & Exterior cleanliness - l
- IV. Safe driving - m

Factor 02 includes 03 variables collectively defined as “Operational factors – F(b)”.

- I. Travel schedule flexibility - n
- II. Distance from origin to Expressway entrance - o
- III. Distance from expressway exit to destination - p

Factor 03 includes 04 variables and collectively defined as “Convenience of travel – F(c)”.

- I. Travel time - q
- II. Mobility - r
- III. Traffic density - s
- IV. Passenger queue length - t

Factor 04 includes 03 variables and collectively defined as “Passenger expectations – F(d)”.

- I. Bus brand - u
- II. Adequate space on board - v
- III. Bus availability rate - w

Thus, it is evident that perception on use of expressway depends on passenger requirement, operational factors, convenience of travel and passenger expectations.

$$F(a) = (0.291) j + (0.319) k + (0.306) l + (0.272) m$$

$$F(b) = (0.318) n + (0.407) o + (0.394) p$$

$$F(c) = (0.316) q + (0.386) r + (0.398) s + (0.295) t$$

$$F(d) = (0.370) u + (0.558) v + (0.475) w$$

L. Pearson Correlation Coefficient for Extracted Factors

H₀: There is no correlation between the jth factor and the satisfaction level on normal route public transport journey

H₁: There is a correlation between the j^{th} factor and the satisfaction level on Expressway public transport journey ($j = 1$ – Passenger requirement, $j = 2$ – Operational factors, $j = 3$ – Convenience of travel, $j = 4$ – Passenger Expectations)

Accordingly, the values significantly depict that there is no correlation between the passenger requirements, convenience of travel and the passenger expectations with the satisfaction level while there having a correlation between the operational factors with the satisfaction level of the expressway public transport.

V. CONCLUSION AND RECCOMENDATIONS

This study aimed to provide a cohesive and detailed assessment of the determinants which affect in Hambantota district public transportation users when selecting a travel route, and two routes as E001 and A02 was compared and studied.

In normal route (A02) journey, nine independent variables have been identified and those variables were extracted under 03 main factors respectively named as: nature of travel, passenger requirements and convenience of travel. By using correlation coefficient, 02 factors separated and identified (nature of travel and passenger requirements) effecting for passenger satisfaction on normal route journey. As per the Expressway Journey Analysis, 04 factors have been identified out of fourteen variables which directly affected to the passenger satisfaction when selecting expressway, namely passenger requirements, operational factors, convenience of travel, passenger expectations. Amongst, passengers were only correlated with the operational factor.

In conclusion, by analysing both normal route (A02) and expressway (E001), it can be stated that the factors named as nature of travel, passenger requirements and operational factors are the highly sensitive factors towards passenger satisfaction. Hence, a slight change in these factors will highly affect towards the passenger satisfaction. To increase the passenger satisfaction and to get more people attracted towards the expressway, the extracted factors could be considered.

It is further recommended, these findings are important when influencing policy makers, related authorities and regulatory bodies (Ministry of Highways, Ports and Shipping, Road Development Authority) to improve the services provided by public transportation in order to increase profit of the expressway by increasing income, and to improve the quality of country's transportation service by addressing customer requirements and finally to expand the capacity of convenience also by avoiding operational losses in order to attract more users to expressway public transportation.

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Best Solution for the Graphic Problem: A Single GPU or A Multi-GPU or An Upgradable GPU

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Abstract— Graphical Processing Unit (GPU) or in general graphic cards or VGA (Video Graphic Array) cards become major hardware of the computer world. After the development of the Graphical User Interfaces (GUIs) of Operating Systems (OSs), the most developed hardware after the processor is a graphic card. But a graphic card is consisting of a fixed amount of memory. It is the major limitation to use a graphic card for a certain big task because the memory limits the amount of data that can store in the graphic card. This paper briefly examines the possibility of installing more memory on a graphic card by the user according to the specific task.

Keywords— Graphical Processing Unit, Graphics Cards, Computer Hardware, Memory, Graphical User Interfaces

I. INTRODUCTION

When computer operating systems are introduced to the world the major part of the operating system was its interface. After adding more colorful graphical user interfaces for the operating systems the companies needed such enhanced methods rather than the Command Line Interface (CMD). The result was a GUI. By using GUIs users can handle the system very easier than the CMD. The computer needed a highly accelerated unit to display rich graphic content. Now we called it the computer graphic card.

Up to now, there are two major GPU (Graphical Processing Unit) vendors in the market. Both companies upgraded their graphic cards with the latest technology and more competitive technology. NVIDIA is a name in the graphic chipset industry with a tremendous brand name and a very big market value [1]. For every eighteen months' time gap NVIDIA releases their latest high technological graphic chipset. TURING architecture is the latest architecture that NVIDIA uses to create its new tremendous graphic cards [2]. Up to now, the best graphic chipset is called as NVIDIA RTX 30 series. Those chipsets are created with the latest technologies and the same TURING architecture NVIDIA used to create their previous graphic cards.

The next major graphic chipset vendor is AMD (Advanced Micro Devices) [3]. AMD graphic chipset series is called AMD Radeon and AMD Vega. AMD is using as their architecture called AMD VULCAN architecture. The VULCAN architecture is created by AMD to give a fast performance to the user [4]. Up to now, both companies have a very good competition throughout the graphic chipset

industry. The latest graphic chipset released by AMD is AMD Radeon RX 5000 series [5].

Most of the time those GPUs are used to create more powerful, more customized graphic cards to give more and more performance to the users. There are many more subsidiaries that created graphic cards. ASUS, MSI, Gigabyte, EVGA, and Zotac are the topper most famous graphic card manufacturers of the time.[6] Every graphic card brand has its technology and its unique performance when comparing with other graphic card manufacturers [4]. however, all those graphic cards are manufactured by the GPUs from major companies, NVIDIA and AMD.

By using a single graphics card, it gives some limitations to the user. There is a maximum number of tasks that can be done by using a graphic card. As a result, both companies created different technologies to use more than one card at a time for the workload. By using those technologies users can use more than one card at a time and the user can parallel use the cards at the same time. The technology that came from NVIDIA is called SLI (Scalable Link Interface) [5]. By using NVIDIA SLI technology, the user can add up to four graphic cards at the same time. To use the SLI technology user needs a module called NV Link bridge to connect those cards to each other.

From AMD the technology that came to the competition for multi-GPU is AMD Crossfire technology. As same in the SLI technology, using Crossfire technology users can use up to 4 graphic cards at the same time [6]. Crossfire technology was not much famous as SLI technology from NVIDIA because most of the time users create a scale, the best graphic cards are the cards that have NVIDIA chipset for multi-GPU scale. The reason was most of the latest software is recommended to use with NVIDIA GPUs to take the most UX (User Experience) from the software.

II. OBJECTIVES AND RESEARCH QUESTIONS

The section indicates three general and specific objectives that the author intends to study as indicated below:

General Objectives

1. Compare single GPU and parallel GPU technology.
2. To Implement a new graphic chipset which can upgrade its memory.

Specific Objectives

2. Is it improve the performance of a graphic card, by upgrading the VRAM?

The section covers three research questions that the author intends to research which are indicated as shown below:

1. Can multi-GPUs be replaced by a single GPU to gain a higher performance?
2. Is there any possibility to create a graphic card that has several memory card slots?

III. LITERATURE REVIEW

Graphic cards are used in the computer industry not only used to display the output of the process from the system. They are used to do far more complex things. The most and the latest example is because of the high processing power graphic cards are used for cryptocurrency mining. For cryptocurrency mining, it needs very high processing power. The processor is not enough for all the tasks in the mining process because the same processor is used to control all the computer processes at the same time. Therefore, GPU processing power is a very rich power source for the mining process [8]. For the mining process, the miners used very high-end graphic cards because all high- end graphic cards are extremely powerful. Now the most famous cryptocurrency mining process is blockchain. Today the most single powerful graphic card for the mining process is NVIDIA GeForce RTX 2070 super [9]. By using more than a single GPU the mining process can be accelerated because always two or better than one. By accelerating the process, the mining process is enhanced. Therefore, in the cryptocurrency mining field multi-GPU is a good way to increase the performance of the whole system and it improves the efficiency of the process.

Deep Learning (DL) is another field that needs a very high GPU power [10]. Deep learning is a subset of the more extensive collection of Machine Learning (ML) techniques. According to "FRANKDENNEMAN.NL", it briefly explains that GPU is a requirement for ML because always a huge amount of data is used in ML. Without a GPU it took too much time for the processing. But the efficiency is increased with the use of a GPU [10]. Therefore, most of the time to have a higher performance there should be a GPU. With the use of multi-GPU, the performance can be more increased because several GPUs are doing the same task at the same time. Again, efficiency is more increased because the process is being in a parallel way. This paragraph proves that multi-GPUs are enhanced the performance of the DL systems. Therefore, this is another fact that multi-GPUs are high performance rather than a single GPU [11].

Another most famous sector that uses the most of the GPU power is 3D rendering and video editing [12]. For these kinds of graphical tasks, it needs very high-performance graphic cards. According to "bison-tech", the best graphic card for 3d rendering is NVIDIA RTX 2080 Ti when the paper is written [12]. The best way to rendering a graphical task is by using a multi-GPU platform. By using two or more graphic cards at the same time graphic cards enhance the performance and quickly render the task with a minimum amount of time. The

1. What is the most powerful technology, a single graphic card, or multiple graphic cards?
time required for rendering is the biggest problem in the field of 3d modeling because it needs more time for rendering. When the task has many more pixels then the time is increased. By using the latest technology, the time can be reduced. Because always using multi-platform the rendering task becomes very quick. Therefore, another use of parallel graphic cards is, that enhances the power of 3D modeling.

According to the above-mentioned situation always it proves that using two or more graphic cards is efficient rather than using a single graphic card. However, it did not depend on the number of cards. Most of the time using the latest technology users can reduce their time and gain a very rich user experience. With the latest GPU technology by using a very high-end graphic card can cost a lot of money, but without using several cards a single high-end graphic card can perform well with the system. But if the task needs more graphic power then the best solution is to use parallel graphic cards.

To use a computer very fast and accurately, it needs a good processor. Then the computer needs a RAM (Random Access Memory) to store the data. The motherboards have several RAM slots to add more RAM cards to the computer to speed up the computer system. The motherboards have a special kind of operating system to understand all the input and output devices to the motherboard. It is known as BIOS (Basic Input/Output System). BIOS can understand all the devices that are attached to the motherboard. Like in the motherboard graphic card needs a very big amount of VRAM (Video Random Access Memory) to give the best performance of the graphic card. However, all the released graphic cards have a fixed amount of VARM. The best and the latest graphic card from NVIDIA, NVIDIA GeForce RTX 2080 Ti. It has 11GB GDDR6 (Graphics Double Data Rate) memory. AMD Radeon RX 5700XT is the best graphic card from AMD and it has a memory of 8GB GDDR6 [13].

To avoid the limitation of the VRAM of a graphic card the graphic card manufactures can create an area to install VARM cards. To create such a customized graphic card the graphic card, should have the capability to read the input. Like BIOS to the motherboard graphic card should have a system called BIS because there should be a way to read the newly installed VARM. According to the authors' opinion by adding more VRAM to the graphic card, it can increase the amount of data that can store. By using this technology, it is a better way to create a new graphic card that can customize by the user to the user's method. But the question with the technology is the GPU must be created to understand the new hardware installations to the graphic card's motherboard.

The new technology mentioned in the above paragraph will help to create a mid-range high-end graphic chipset and there is another marketplace for VRAM cards. The most important thing is, for a certain specific task the users can create a specific unique graphic card according to their purpose. Therefore, it will become a low-cost graphic technology with different kinds of chipsets and VRAMs.

IV. METHODOLOGY

This research was conducted using primary and secondary quantitative data. Firstly, a study was conducted to analyze the data collected from all major graphic-card vendors and all major GPU vendors. In addition to that, another qualitative study was done to analyze all the gathered data from previously published research papers. Secondly, a study was conducted to calculate the quantitative data. A survey was done by focusing on most of the graphic designers, game developers, 3D modelers and researchers related to the subjects of data science and Artificial Intelligence. The above group was used because the mentioned category needs more graphical power in their industries.

A questionnaire was created by focusing on the above group because for the study, the author needs to use the people who are related to the industries which use more graphical power. The sample was not a large one, because there is a smaller number of professionals who related in the mentioned fields. A few interviews have been done with some experts who use the latest technology and the latest graphic cards with their systems. All the information in this paper was collected by the mentioned quantitative and qualitative data.

V. RESULTS

From the research conducted by the authors, there are so many solutions for the graphic problem. The best answer is to buy a high-end graphic card that costs most of the money of the user. From the research, the authors found an answer that, most of the users are going to buy or bought the high-end cards who can go for a highly costing one. Therefore, a very high-performance graphic card can easily use for the tasks that are mentioned in the paper. But there is a question with the high-performance single cards. It doesn't have any ability to run parallel tasks. The solution is user need to buy two or more cards for parallel processes. Those cards must have same specifications with the same technology. Again, it is costing more money of the user.

There are advantages and also disadvantages by using multiple graphic cards in a single system. The most unique advantage is the system becomes an extremely powerful computer system with those two graphic cards. The system is much more enough to perform all the tasks mentioned in the paper. Parallel GPUs give high-performance as well as work as an accelerator for parallel applications [14]. That is the major advantage of the parallel GPU computing. Then as mentioned above in the paper, mining cryptocurrency become very easy because of multi-GPU systems

In other high-performance tasks like DL, ML, and Neural Networking, everything became very easy to perform using the mentioned technology. As a result, Artificial Intelligence (AI) and related technologies become very familiar to our day to day lives. Therefore, most of the industrial and day to day life's computational activities took the advantage of parallel GPU computing. However, the main disadvantage of the multi GPU platform is it needs a very big power to power up

the system. And a very powerful cooling system to control the heat generated inside the computer system.

According to the survey conducted by the author, the results are as follows. The survey was conducted by using a group of people who are related to the industries such as game development, 3D modeling and animation, machine learning, and deep learning with the addition of data science.

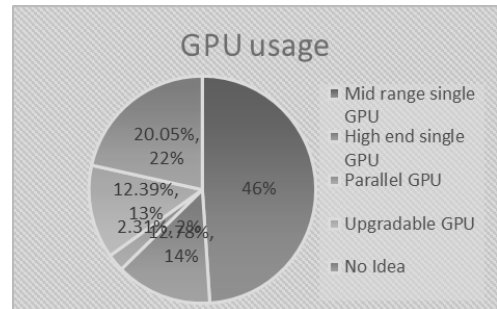


Fig. 1 GPU Usage

From the results, it generates more ideas about the knowledge and the usage of the graphics cards. Most of the users around 45% are agree with mid-range cards according to their budget range because mid-range cards can add more performance to the systems but less than high-performance cards. Then the maximum number represents the users that they don't have any idea about the graphic cards and also the performance of the graphic cards. It shows us the knowledge of the users about this kind of technology. 14% of all users are agree with the high-end graphic cards. Therefore that 14% have the chance to go with the high-cost graphic cards. And most of the industry level game developers and 3D animators are in this category because they used very high-end technology for their workload.

Then the maximum number of users are agreeing with the technology that is going to be implemented in the future. That is 12.39% of all the users. The statistical data from the survey, shows us that most of the users are need to use high-end technology and performance. But they are facing some limitations in their lives. Therefore the newly implementing technology is the best solution for them.

The least number of users are belonging to the category who are using or going to use parallel GPU technology. Again, some of the game developers and data science researchers belong to this category. They also agree with the implementing idea because they have simple solutions, rather than being buying another graphic card for their computer system.

The last technology described in the paper was to create a graphic card that has the opportunity to upgrade its VRAM. That means the user can customize the graphic card according to the task that the user needs. To create such a graphic card, new technology should be implemented with a new type of graphic chipsets and a new type of graphic motherboards. It will be a low-cost high-end graphic

technology that everyone can afford. As a result of it, another new technology should be created. A RAM card that consists of GDDR technology because all the graphic cards are consisting of GDDR memory. Or like other mentioned technologies a new technology should be created for the memory cards.

With the discussions had with the tech experts, game developers, Artificial Intelligence researchers who have much more experience in the graphic industry, they have much more different ideas. Most experts take the side of a single GPU which consists of the most tremendous and high-end technology. The reason for that was the cost that they have to pay to buy a graphic card is less than the cost that they need to buy two cards. By the way, their condition is fine with their budget range and the workload that they have to do. This is not a complete survey because the number of participants is very less and the only category that the authors choose was only the experts who are in the fields of graphic designing, 3D modeling, game development, data science, and machine learning.

VI. CONCLUSION

Due to the lack of technological knowledge and experience, most of the users are going to use technology that is not enough for their specific tasks. Therefore, most of those users face much more difficulties using their computer systems because of the previously mentioned situation. The selection of graphic cards has also become difficult because the user does not know which kind of graphic card that they need and which kind of specifications should in the graphic card. Especially the clock speed, and the VRAM. Because of that reason users are spending more money on the graphic cards even it is affordable or not. A very few can take this chance but most of the people remaining with a mid-range card. Therefore, those users can buy cards with less amount of memory. It is a very big question when doing a specific task that needed a big amount of VRAM. But the graphic cards VRAM is a fixed amount and it cannot be upgraded. There is a new technology for the question that is mentioned in the paragraph.

Throughout the paper, it describes a new graphic technology that can upgrade its VRAM of the graphic card. With the implementation of the new technology, there will be another great solution for the graphic problem. Therefore, all the users will have another option to go with when buying graphic cards. It will be a low-cost high-performance solution for all the users mentioned in this document.

In conclusion, modifications must be implemented in all sectors of graphic chipset and graphic card manufacturing industry, as well as motherboards. With the results that generated from the survey show us most the users are waiting for new high-tech solution for their graphic problem. Therefore, the new technology will be the best answer and the only solution for their budget and also to their requirement.

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Dynamic Route Planning (DRP) Module for Distribution Business

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Abstract — In the Sri Lankan logistics industry, delivery route planning is a very important and critical task. It requires many skilled labours and is time-consuming as well. The project aims to develop a Dynamic Route Planning (DRP) Algorithm to computerize the task and make it fast and efficient. The system comprises many features, including identifying the fastest route to deliver goods to all the given delivery locations (drop points). It also captures the cargo volume, vehicle capacity and provides an indication of the number of vehicles required to complete the full delivery by running a calculation using the volume of the cargo and truck capacity. The biggest challenge faced in developing the algorithm is calculating the distance among the delivery locations electronically. There are many electronic maps found online but each one has its own drawbacks. Most of the maps do not get an update very frequently, and changes on roads are not available. There are some maps, which are restricted to use in certain countries and not allowed to use worldwide. The algorithm and application what this project expecting to develop must be available to use in any country. Finally, we derived to a point where we can use Google maps which has minimal negative points. This project uses Google Maps as a tool when it is calculating the distances between two points, and inbuilt intelligence of Google Maps to identify the fastest route between two delivery points (drop points). At the beginning of the development of the algorithm, knowledge extracted by studying Dijkstra's Algorithm, which is used in Google Maps, supported to identify the direction of experiments. There are certain limitations in the use of Google Map APIs. As well as the number of hits made per day in the free version is limited and identifying different graded roads such as "A" & "B" are some of them. Users can upload the details of the cargo and delivery location (drop point) details to the application. The application will then generate the fastest route in a report form or plotted in the map.

Keywords— Dynamic Route Planning, Cubic Meter, Application Programming Interface (API), Drop points

I. INTRODUCTION

The business who is doing B2B (Business to Business) or B2C (Business to Customer) are using third party logistics providers to provide services for their business. Warehousing, Cargo Distribution are some of the services that third party service providers can provide. These two services always go hand in hand. Because, warehousing is, storing cargo in a facility and dispatch those based on the orders. Transportation is, distributing the card in which they were dispatched from the warehouse to another businesses or customers.

Most of the distribution companies, maintain delivery schedules with static routes. When we analyze this distribution methodology and after talking to industry experts, we have identified, these

scheduled deliveries can lead to customer dissatisfactions [1]. That can create delays in deliveries. Because, if the warehouse missed the scheduled delivery date when they dispatch the order, then the order will be delivered by the other week as a result the delivery is delayed by a week. This delay can be a week if the distribution company maintains a weekly schedule. If they are maintaining monthly schedules, that can lead to a one-month delay as well.

A solution is needed to be derived to do the deliveries in dynamic routes. That is without following scheduled deliveries, distributor to follow routes dynamically based on the orders for a particular day. In that way, the distribution company can minimize the delays up to a great extent. However, route planning will be the challenge because the number of combinations which can be available in arranging the delivery points (drop points), going up to millions depending on the number of them. It is not possible for humans to calculate all the combinations and find the fastest route.

As a solution, this research proposed an algorithm to find the fastest route to reach all the given delivery points. In this algorithm, users must be able to upload all the delivery points (drop points), and the algorithm will break the locations into multiple zones based on their geographical locations and then calculate the fastest routes within the zones. A prototype can prove the accuracy of the algorithm. For the prototype, it is given a higher priority for the algorithm and uses a very basic database and a programming language to develop it.

The rest of this paper is organized as follows: In section II, the literature review is discussed. Section III describes the proposed algorithm and implementation result, and section IV describes the conclusion.

II. LITERATURE REVIEW

The primary source of knowledge for this project is the specialised online application available in the market and specialised tools related to route planning.

While researching about available applications, two products were identified in the industry which allows anyone to download free demo versions and which has detailed documentation available about the product. Other applications need to pay and download the trial version or contact sales centre to get further details after registering the business at their website.

1. TrustTrack

TrustTrack is a Fleet Management Solution from Ruptela, headquarters located in Lithuania [2]. Ruptela was established in the year 2007 and founded by Andrius Rupsys. This is a company with a vision to be within the top 40 companies in transport telematics aftermarket globally by 2022. The company has started with three members, and now it has grown to 220 total staff. Today, Ruptela

develop, design and manufacture hardware, firmware and software products for fleet management and GPS tracking. Ruptela provides ready-to-use telematics solutions. Ruptela is an ISO 9001:2015 certified company, and ISO 9001:2015 is internationally recognised as the world's leading quality management standard.

TrustTrack consists of six main features.

Vehicle Tracking: Through GPS technology, the system can track the vehicle location, trip history, and routes vehicle travelled, send messages & tasks to the driver and send notifications.

Connect & Integrate: Users can retrieve details of drivers, vehicles, tasks, routes, KPIs and all other data and display in a single platform. TrustTrack can integrate with other third-party software and web services using APIs.

Telematics: Retrieve data from digital tachograph, CAN bus, monitor fuel level and consumption, rate drivers by their driving style.

User Friendly: TrustTrack is a user-oriented web-based platform with a simple and native user interface. It is a fast and proactive platform.

Mobile Apps: TrustTrack mobile app is very useful option in this solution. Users can log in to the mobile app as the fleet management or as the driver. The features what app returns changes based on the login method.

Admin Panel: Admin panel is a user management platform for tracking service providers. It makes it easier to create, edit, control and bill users.

In addition to those mentioned above six main features, users can utilize few other facilities as mentioned below.

- Check the status of the fleet.
- Remotely download data from the tachograph
- Manage drivers, working time, idle time & resting time.
- Monitor detailed fuel levels and consumptions.
- Rank drivers driving style wasted fuel and efficiency.
- Create the tasks and routes for the particular job and send it to the driver via the system.
- Receive an alert when the vehicle needs to be serviced.
- Manage the vehicle within the pre-set working area using geo-fencing/zoning technology.
- Communicate with drivers through voice or text messages or send/receive files through the application.
- Useful dashboard.
- Customized reports.

TrustTrack mainly focuses on tracking the fleet and managing the vehicle fleet. The challenge that the industry currently facing is identifying the most suitable route to reach the locations from the distribution location. There are many applications bundled with regular GPS solutions to track the vehicle location, check the fuel levels, monitor the route that the vehicle is using, etc. TrustTrack is a reactive solution and industry is looking for a proactive solution. Therefore, the TrustTrack application does not fulfil the requirement that industry is looking for [2].

2. Locus

Locus is an Indian company who is developing IT solutions for the logistics industry. The company started in 2014 by developing an application for a personal requirement. This application was for the women in India for their safety. Then this requirement came for the food delivery companies to monitor their deliveries, and it gave a huge opening for a new avenue in the logistics industry. Locus mainly focus on automation solutions for the logistic industry. Locus on the Road module is designed with some features as mentioned below.

- Detailed and Easy to Use User Interface

Hassel free tasks navigation, with customer details including accurate geocoded locations.

- Electronic Proof Of Delivery

Capture customer signature, product image or QR code at the point of delivery to confirm the goods delivery.

- Reschedule and Cancel Orders

Easily reschedule or cancel deliveries, the basis of customer availability within the app.

- Partial Pickups and Deliveries

The distributor can cancel part of the order to enhance customer experience and reduce logistics costs.

This application has been extended to a mobile app where the drivers can access it from any location [3].

Since the Locus application is mainly focused on the accuracy of goods delivery and traceability, it is not giving intelligence to find the fastest route to reach multiple locations. This tool can be used to stop the use of paper documents and transferred them to a digital platform.

III. METHODOLOGY

After identifying the industry requirements and analysing the existing applications, it is decided that developing an algorithm to plan routes dynamically is the only solution to improve the efficiency in cargo distribution. Google Maps are the most common and frequently updating application available online [4]. To get the support of Google Maps, it is necessary to learn about the Google Developer Console.

Google developer console

Google developer console, previously called as google code, is google's site for software development tools, APIs and technical resources. Additionally, this site contains documentation on using Google APIs which developers can refer and learn how to use the APIs. Sample codes are helpful to proceed with trials. Blogs & group discussions are helpful to understand the possible errors, their solutions and share knowledge.

Google developer console offers APIs for almost all the google's popular consumers such as google maps, YouTube and google apps. This site features a variety of developer products and tools especially for developers.

Google distance matrix API

The distance matrix API is a service that is provided by Google to get the travel distance and time for a matrix of origins and destinations. Since the security is an important fact, applications can use https and prevent from snooping or tampering. The respond of the request can be received in json or xml files. If the developer mention "json" as the output format in the request parameter, respond receive as json, if it mentioned as xml, respond receives in xml.

Request syntax

```
https://maps.googleapis.com/maps/api/distancematrix/json?origins =
<origin latitude>, <origin longitude> & destinations = <destination
latitude>, <destination longitude> & language= en-en &
sensor=false & avoid=highways & key= <key>
```

Parameters

Origin : this is a mandatory parameter in google distance matrix API. When the application wants to check the distance between two geographical locations, the starting location is the origin. When the application passes the parameter of the origin, application can pass either the location address or the latitude and longitude co-ordinations. It is recommended to use the latitude and longitude co-ordination rather using the location address because in a location

address, there is no specific number of elements, and each element needs to be separate by the plus “+” sign. Furthermore, if the address is not registered in google, API cannot identify the correct geographical location and return the correct distance.

Destination: this is a mandatory parameter of google distance matrix API. When the application wants to check the distance between two geographical locations, the ending location is the destination. Similarly, to parameter origin, this parameter also can be passed by the location address or latitude & longitude co-ordination. Again, it is recommended to use the latitude & longitude coordination. In this parameter, the application can pass multiple locations and then API can return the total distance to travel all the locations starting from the given origin.

Key : this is the last mandatory parameter that google distance matrix requires. To access google APIs, the application should communicate through a registered account. Users need to create the google account and enable the APIs. Google issues a key once the registration is done and google use that as an authentication while application is accessing the API. Additionally, Google maintains a quota for each registration and that quota also managed by the key. There are a few more optional parameters which users can use in their applications.

Mode: this is the parameter which application inform the API the mode of travel. The default is “driving”. Additional to “driving” users can use “walking”, “bicycling” & “transit”.

Language: google API can respond in multiple languages. Default is English. (refer the appendix 1 for other languages)

Avoid: while google is finding the path between two locations, there can be some options to be avoided. Such as roads with tolls, expressways, etc. (refer the appendix ii for all the possible avoids)

Units: This parameter sets the type of measurement to return the distance in API response. Google API supports two types of units that are metric & imperial.

There are few more optional parameters that can be used with google API such as traffic-mode, transit-mode, transit-routing-preference, etc. [5]

1) Identifying the Requirement

In Sri Lanka, logistics is a newly booming industry. Cargo distribution is one of the major tasks in logistics. Cargo distribution in modern trade or general trade is a daily requirement. There are thousands of deliveries happening in Sri Lanka every day, and all these distributions need a perfect route planning [1] [6].

Currently, all the route planning happening through standard delivery schedules, and there are hidden costs and wastages within the distribution. Skilled route planners are an essential requirement in manual route planning, and it is an unavoidable cost for a company [1][6]. Humans can make mistakes, and that can lead to a loss for the company as well.

Dealing with the customers always need proof to ensure the route that the company used is the most efficient route for their cargo distribution. System generates route plans always gives an additional confidence for the customers, and it can be an added advantage to the company to get many more businesses and compete with the competitors within the industry [1] [6].

By the research conducted for this project, it was clear that dynamic route planning always needs to go with online maps that has the accuracy of 99% [1][6].

2) Limitation

There are a few identified limitations in this project.

Geo-coordinates - This algorithm totally depends on the distances between drop points. To calculate the drop points, it is compulsory to have the geo-coordinates of each and every drop point. The system cannot continue without the geo-coordinates. There are Google APIs that returns the geo-coordinates of the location if the

system can pass the postal address to Google as a parameter. However, google can return wrong coordinates or may not return the coordinates if the postal address is not registered/ found on google maps. In this phase, this project does not facilitate to do the route planning based on the drop point postal address.

There is a limitation in the number of hits that Google maps can allow per day in its free version. If the user plans to have many route planning sessions with many drop points on a daily basis, the user needs to purchase the google API license. Some routes google picks are not accessible by bigger trucks. There is no parameter in google API to avoid that type of route. Therefore, there are situations where truck/lorry cannot travel in the route that google suggest and, in that instance, the route plan that this algorithm gives may have a slight difference from the actual route that the truck/lorry can travel.

Google always returns the distance of the fastest route and not the shortest route. The fastest route depends on the traffic situation at the time of planning. Users can do the planning, may be nighttime or the previous day of the actual delivery. However, the distribution can happen at a different time. The traffic situation at the time of planning and actual delivery can be different. Therefore again, the planned route can differ from the actual route.

3) Algorithm

Problem

There are a set of delivery locations that are changing randomly. Need to find the fastest route to reach all the location from the distribution point.

Assumptions

There are a few assumptions in this algorithm.

1. User can upload the correct geo co-ordinates of all the locations, and all the locations are valid location and application do not verify it.
2. All the geographical locations are accessible by road. No other transport mediums (sea and air) to be used.
3. Application do not need to warn if the user uploads a location which needs another transport medium to reach the location.
4. Only single-origin location available for a route plan and no multiple pick-up points.
5. Application does not verify the number of pick-up points.
6. User has updated all the available vehicle types in the Fleet Master Table

4) Tools

To find the fastest route, need a solution to find the distances between the locations, which are changing randomly. Electronic Maps (online maps) can be used as a tool to find the distances between the locations. When a third-party program communicates with the online maps, it is necessary to pass the Longitude & Latitude coordinates of the locations or location's addresses as parameters. Then the map can return the distance between the two locations. Here Google Maps APIs can be used to communicate with Google Maps, through a third-part program and read the response. Google APIs can return the respond through json or xml. Communicating using json or xml, third-party program can identify the distances, avoids or include/exclude roads with tolls, etc.

Since the purpose of the project is to test the algorithm, the prototype can be developed using any programming language. In this project, Visual Basic 6 has been selected as the programming language for the development of prototype and Crystal Report as the reporting tool.

5) Process

Google Maps are already using an algorithm to identify the route between two geographical locations, and it is commonly used in the world. The studies of google maps and the algorithm used in that which is “Dijkstra’s Algorithm” has been supportive to find the algorithm for “Dynamic Route Planning”. Since the above-mentioned algorithm is used to find the shortest path between two locations. Started with applying the Dijkstra’s Algorithm to Dynamic Route Planning as it is. Then the result was, the system is returning the best single route to serve all the delivery locations. However serving all the delivery locations using a single route is not practical, and it is not benefitting to the cargo distributor. Then started to find a solution to break the route into zones using the proposed method. Finally, the method shows in *fig. 1* returned the best route to serve any given locations.

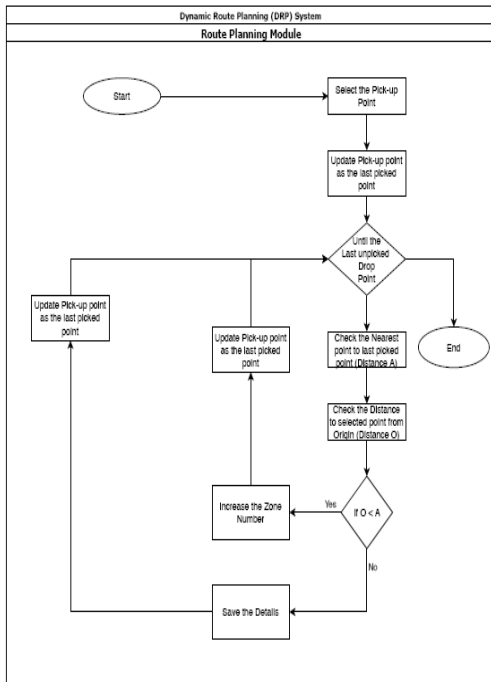


Fig. 1– Dynamic Route Planning Process

6) System Testing

Now the project has come to the most important stage where the prototype is developing and testing the final results. After the problem is identified, done the successful research on existing solutions and identified the advantages and disadvantages of those solutions. Literature reviews allowed to get a good knowledge about the existing tools and logics what those tools are using when they calculate the fastest distances to a location from another location. By improving those methodologies, this project was able to come up with a perfect algorithm to identify the fastest route to reach multiple locations from a single distribution location. This is the first time this type of the logic is implementing in Sri Lanka and testing multiple scenarios can confirm the accuracy of the algorithm.

Test Case 1

They are distributing from Warehouse in Muthurajawela Industrial Zone to 17 locations. The distributing locations are as follows in Table I.

TABLE I
LIST OF DROP LOCATIONS

Location Name	Latitude	Longitude
S051-Ahangama	5.97331905	80.36201477
S053-Alawwa	7.29728699	80.23690796
S017-Aluthgama	6.43073988	79.998909
S054-Ambalangoda	6.23655796	80.05323029
S055-Ambalanthota	6.12268496	81.02935791
S122-Balangoda 2	6.6476123	80.7005585
S025-Bandarawela	6.83047819	80.98975372
S026-Badulla	6.99085188	81.05352783
S150-Galle 1	6.05007696	80.22026062
S323-Hambanthota	6.12510395	81.12612152
S329-Hikkaduwa	6.14270306	80.0996933
S381-Jaffna	9.66859722	80.01738739
S456-Kalpitiya	8.2323128	79.7609274
S006-Kaluthara	6.58225012	79.9598465
S419-Kataragama	6.4150548	81.33216858
S514-Mannar	8.9767116	79.9142487
S658-Polgahawela	7.33611917	80.30046082

The system should group these 17 locations into zones as mentioned in *Point 5 - Process*. The system processed the above uploaded locations as shown in figure 2, and the algorithm has grouped those 17 locations into 4 zones.

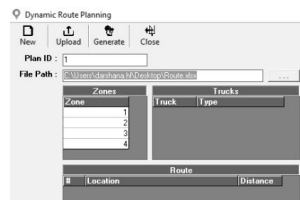


Fig. 2– Routing Zones

Zone 1

The system has identified two delivery points in Zone 1 from Spectra Distribution

1. S053:Alawwa
2. S658:Polgahawela

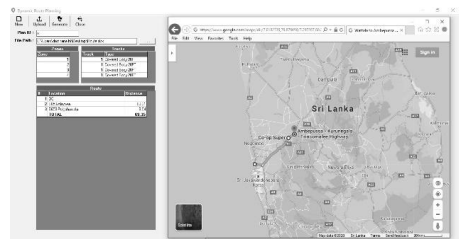


Fig. 3– Zone 1 Route

Zone 2

System has identified 9 delivery points in Zone 2

1. S006:Kaluthara
2. S017:Aluthgama
3. S054:Ambalangoda
4. S329:Hikkaduwa
5. S150:Galle – 1
6. S051:Ahangama
7. S055:Ambalanthota
8. S323:Hambanthota
9. S419:Katharagama

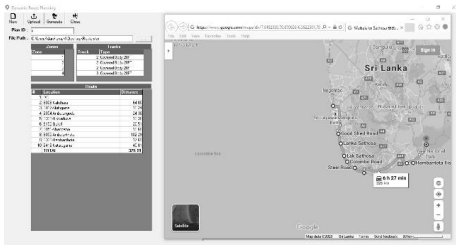


Fig. 4– Zone 2 Route

Zone 3

System has identified 3 delivery points in Zone 3

1. S122:Balangoda 2
2. S025:Bandarawela
3. S026:Badulla

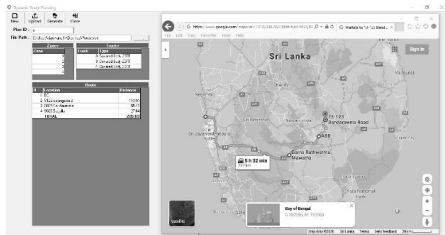


Fig. 4– Zone 3 Route

Zone 4

System has identified 3 delivery points in Zone 4

1. S456:Kalpitiya
2. S514:Mannar
3. S381:Jaffna

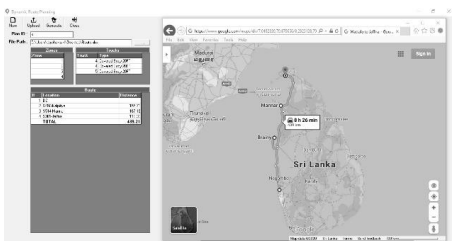


Fig. 5– Zone 4 Route

IV. CONCLUSIONS

The Dynamic route-planning algorithm was developed with the learning of Dijkstra’s Algorithm. Dynamic route planning algorithm is an extension of Dijkstra’s algorithm. This algorithm helps users to plan their daily deliveries in an easy and most efficient way within a small period. Implementing this algorithm with an online web-based interface, it can use as a common route planning online platform for any distribution centre. Furthermore, the density data were stored in database and, analysed to understand volume of orders being placed in geographical areas within the country and forecast about the demand and more information.

System allows users to add/remove orders at any time and re-plan the routes within a small-time frame. This increases the flexibility of the delivery and it is a value-added service for any distribution company. When the vehicle fleet follows efficient route in distribution, the fuel cost and time can be reduced which can bring much more benefits to the business. On-time deliveries will positively impact on the company brand and increase the trust and reliability of the company from customer point of view.

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Factors Affecting for the Service Quality of Three-Wheeler Transportation in Kurunegala City

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Abstract - Public Transport service is vital to the wellbeing of any country. Three-wheeler transportation service in Sri Lanka has become poor in quality and unreliable due to the expectations of passengers. Therefore, the scope of this study was limited three-wheeler transportation in Kurunegala city. Quality service is a procedure of total evaluation of service or product. If the service provider is separate from the service it offers, then the passengers regularly get attached to the service quality. Transportation service in Sri Lanka is in poor quality because it does not meet the passenger expectations and needs. Quality three-wheeler service implementation in urban areas is a main concern to regulators as well as to the passengers.

Quantitative research approach has been conducted to analyse data in the study. Therefore, 306 passengers have been used as sample population and then exploratory factor analysis has been used to identify the major quality factors. SPSS version 16.0 has been used to analyse data.

There were 19 independent variables taken by referring to past studies. Next, research objectives were identified, nature of service quality dimensions and overall service quality, relationship between individual factors and service quality and significant factors influencing on service quality of three-wheeler transportation in Kurunegala City.

Finally, researcher evaluated the overall service quality level of three-wheeler service in Kurunegala city and proposed several solutions to increase the service quality related to three-wheeler transportation. This research also provides some recommendations to develop three-wheeler service in near future and recommendations to make a good quality service to the passengers in order to fulfill the passenger satisfaction about service quality of three-wheeler transportation.

Key Words - Kurunegala City, Service Quality, Three-Wheeler Transportation, Transportation,

I. INTRODUCTION

Transportation is known as undertaking of societies or possessions from origin to destination in separate land, air or water. Transportation has been defined as an essential thing when transporting merchandises, determination of living. Hence that, road transportation has become an imperative transport mode in the world. In early days people used non-motorized transport modes like walking, riding on animals and cycling. Things have changed because of globalization and a huge development can be seen in conveyance. Nowadays motorized automobiles like motorcycles, three-wheelers, cars, vans, buses are often used by people. In the present world people have achieved their daily fulfilments by road, rail and air as well.

Nowadays, competition for transportation has grown rapidly because of the increasing urban development in Sri Lanka. That's where three-wheeler services have the importance in transportation sector. The demand has increased because of work, education, shopping, entertainment and many other places related to important activities. So, passengers do not need to own a vehicle because the passengers can travel to a place where needed by using a three-wheeler. So, at present, people have a habit of using three-wheeler transportation very often.

Personal travel can be identified as an important need of the people and the government is obligated to step up their people's (society) basic needs. As a solution, a public transport system is existing in Sri Lanka and the government also tries to provide an efficient, cost effective and environment friendly transport service. In addition to that the private transport also exists due to the fact that public transport itself cannot fulfil all the travel needs of people in society and also due to different travel desires of them. However, in the present context, both public and private transport have failed to cater to the growing passenger demand of transport especially in urban areas. As a solution, the three-wheeler transportation is raised as

an alternative private transport mode and it has become a much common sight in Sri Lankan transport system.

Three-wheeler taxis are a key part of Sri Lankan public transport network especially after dark when buses stop operating due to state mandated fares which do not permit night fares. Once the travellers are satisfied then three-wheeler transport is credited with delivering effective facility opportunities therefore the major function of three-wheeler transport sector could be structured around satisfying the passenger. There is one type of three-wheeler service providers in Sri Lanka, which have different colours and most of them in Sri Lanka use Indian Bajaj model. But there are few brands of three-wheelers such as Piaggio Ape, TVS King.

Evaluation of service quality of urban transportation system is vital to improve productivity, gain profits and increase customer satisfaction. All transportation organizations carry evaluation of their service quality on a regular basis. This involves assessment of various parameters related to service quality for example, efficiency, reliability, safety, etc. the goal of all organizations is to achieve high customer satisfaction by providing high quality service at all times to all customers (Awasthi, et al., 2011)

A. Research Question and Objectives

Question 01:

What is the nature of service quality of dimensions and overall service quality?

Question 02:

What is the relationship between individual factors and service quality of three-wheeler transportation?

Question 03:

What are the significant factors that influence on service quality of three-wheeler transportation in Kurunegala city?

Objective 01:

To understand the nature of service quality dimensions and overall service quality.

Objective 02:

To understand the relationship between individual factors and service quality of three-wheeler transportation.

Objective 03:

To determine the significant factors, influence on service quality of three-wheeler transportation in Kurunegala city.

B. Significance of the research

Three-wheeler has become a common transport mode in Sri Lanka, especially in the urban areas. Among the urban cities, I have chosen Kurunegala city to conduct this survey as Kurunegala is the capital city of the North Western province and in Kurunegala district. Kurunegala is the main financial and congested city and rapidly industrial developing, urbanizing area in Sri Lanka which is also has working and many different ethnic

communities, residing population around 80,755 (Department of census and statistics) Kurunegala city is also known for being one of the popular business destinations. Therefore, this research will be more valuable because this is the first survey done for the Kurunegala city.

Outcome of this study identifies the factors affecting service quality in private three-wheeler transportation in Kurunegala city which will be more important to parties who are engaged in private transport as a business as well as for the government to identify the requirements in order to maximize service quality and customer satisfaction and enhance the existing service.

This study also shows the significance of three-wheeler as a way of transport in Kurunegala city area and it shows the usefulness of the three-wheeler transport to the people of Kurunegala city.

C. Literature review

According to the Wijesundara & Ushantha, 2018, they have conducted their study to identify the service quality factors of three-wheeler transportation as the mode of tourist transportation in Sri Lanka. Data were collected from tourists who travelled to Ahungalla tourist's region of Sri Lanka and data were gathered by using both self-administered questionnaires and interviews. The study found that service quality was high in the main segment as a resultant of segmentation. They have identified the reliability, responsiveness, tangibility, assurance and empathy as the main factors for passengers to get satisfied with three-wheeler transportation. Tourists were also dissatisfied with some service quality dimensions and best practices in these aspects must be enhanced to uplift the existing service quality level of three-wheeler transportation. (Wijesundara & Ushantha, 2018)

There was a study based on analysis of the economic and social parameters of the three-wheeler taxi service in Sri Lanka. Data were collected from 200 operators and 100 passengers from a divisional secretariat area in Colombo district. This study covered a number of details pertaining to ownership, management and fare structures, as well as opinions on the service quality attributes by users. They have identified economic and social factors as fundamental factors. (Kumarage, et al., 2010).

Based on this research Nishantha, 2017, they have conducted their study to identify the development of a fare structure for the three-wheelers. And this survey shows that the three-wheeler is best for shorter distances (last mile connecting) and not efficient for longer distances. He has identified fare price irregularities using analytical techniques for three-wheeler transport service, professionalism, communication and driver attitudes. He has collected data from Colombo area. (Nishantha, 2017) According to Bandara, et al., 2018, this study focuses on existing socio-economic features and the operational characteristics of three-wheeler taxi services. This survey was conducted with the participation of 340 three-wheeler passengers from Colombo area. After the analysis as a result, they have identified fare price, fare meters,

regulations, travel time, operation hours, age, and experiences as main factors. (Bandara, et al., 2018) .

II. METHODOLOGY

A. Population

Target population for the study was passengers of three-wheeler transportation in Kurunegala city, Sri Lanka.

B. Sample

The questionnaire was distributed around 340 passengers who are using three-wheeler transportation in Kurunegala city and 306 qualified respondents were selected out of them for the sample. The final outcome of the study was mainly based on passengers’ information stated in questionnaire.

C. Sample Techniques

For this research, the sample was selected through simple random sampling method. Simple random sampling is a sampling technique which comes under probability sampling method. Main aim of that technique to be used in the study was due to the fast as well as convenient availability of the subjects as from this technique, sample is selected in such a way that every possible sample of some size is equally likely to be chosen.

D. Data Collection

Questionnaire had been distributed by using online “Google Form”. The questionnaire consisted of 11 questions and 19 variables were included in the questionnaire. After that questionnaire was distributed among the passenger via E-mails and social media networks like Instagram and Facebook and communication methods like Viber, Telegram and WhatsApp.

The main part of the questionnaire which contains independent variables comprised of 5 Likert scale questions. A “Likert scale” is a specific statement, Likert scale is a common ranking format for surveys. Respondents rank quality from strongly satisfied to strongly dissatisfied using five Likert scale levels (Allen & Seaman, 2007) . For this study, Likert scale was used because the focus was upon measuring service quality of three-wheeler transport quality in Kurunegala city. Below table represent the five-point Likert scale.

E. Conceptual Framework

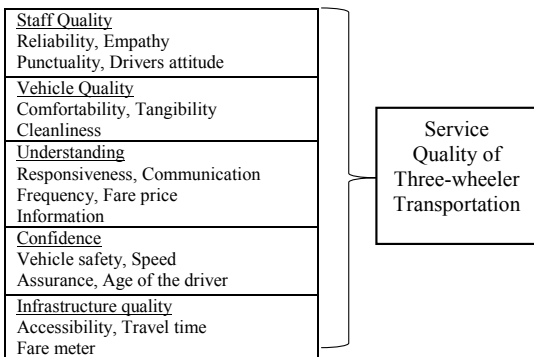


Fig.1 Conceptualization (Source: Author Developed)

TABLE 1
LIKERT SCALE

Strongly Satisfied	Satisfied	Neutral	Dissatisfied	Strongly Dissatisfied
5	4	3	2	1
Strongly Satisfied	Satisfied	Neutral	Dissatisfied	Strongly Dissatisfied
5	4	3	2	1

F. Regression Model

Multiple regression generally explains the relationship between multiple independent or predictor variables and one dependent or criterion variable. A dependent variable is modelled as a function of several independent variables with corresponding coefficients, along with the constant term. Multiple regression requires two or more predictor variables, and this is why it is called multiple regression. The following formula is used to calculate the multiple regression model.

Equation 3.3 Multiple Regression Model

$$y = a + b_1x_1 + b_2x_2 + \dots + b_px_p$$

y = Variable can be expressed in terms of a constants

a = Slope

b = Time the x variable

III. DATA ANALYSIS AND THE RESULTS

A. Nature of Service Quality Dimension and Service Quality

First objective has been addressed using descriptive statistics to understand the responses of passengers with regard to three-wheeler transportation. Results are provided in table 2.

TABLE 2
DESCRIPTIVE STATISTICS

Measures	Staff quality	Vehicle quality	Understanding	Confidence	Infrastructure Quality	Service quality
Mean	3.3497	3.3192	3.3373	3.3023	3.3224	3.5458
Std. Deviation	.89160	.95289	.92214	.90429	.95579	.80135
Skewness	-.506	-.690	-.676	-.631	-.509	-.804
Std. Error of Skewness	.139	.139	.139	.139	.139	.139

Kurtosis	.435	.199	.471	.389	.130	.697
Std. Error of Kurtosis	.278	.278	.278	.278	.278	.278

In relation to descriptive statistics all the mean values with regard to individual factors are in moderate level. They are representing neutral level responses. This is because all the mean values are around the Likert scale 3. Mean value of the service quality is 3.54 this is having somewhat agree level, but it is also marginal. These results indicate that individual factors are not in an acceptable level. According to the standard deviation, comparatively infrastructure quality is more deviated. This is because it consists of highest standard deviation that is 0.95. Service quality has a minimum standard deviation that is 0.8 and it comprises a minimum deviation comparatively. The coefficients of skewness are between -1 and +1 therefore, service quality dimensions and overall service quality are approximately normally distributed. According to these results, individual factors of service quality are not in an acceptable level with regard to three-wheeler transportation.

B. Relationship between Individual Factors and Service Quality

Second objective has been analysed by using Bivariate Correlation Analysis. Researcher applied Pearson correlation analysis and that is a powerful parametric technique. Results are given in table 3.

TABLE 3
CORRELATION ANALYSIS

Individual Factors		Service quality
Staff quality	Pearson Correlation	.373**
	Sig. (2-tailed)	.000
	N	306
Vehicle quality	Pearson Correlation	.369**
	Sig. (2-tailed)	.000
	N	306
Understanding	Pearson Correlation	.328**
	Sig. (2-tailed)	.000
	N	306
Confidence	Pearson Correlation	.364**
	Sig. (2-tailed)	.000
	N	306
Infrastructure Quality	Pearson Correlation	.339**
	Sig. (2-tailed)	.000
	N	306

With regard to the correlation analysis all the p values are highly significant between the individual factors and service quality. Therefore, they are representing highly significant association between the service quality dimensions and service quality of three-wheeler transportation. All the coefficients of correlations are indicating positive figures.

Accordingly, higher the individual factors represent higher the service quality. According to these results service quality of three-wheeler transportation is significantly positively correlated with the service quality dimensions. Correlation analysis gives the relationship between independent factors affecting for the three-wheeler service quality has been analysis by using following hypothesis.

H₀: There is no any relationship between service quality and the independent variable

H_A: There is a relationship between service quality and the independent variable

According to the above table 3, there is a positive correlation between service quality and the staff quality factor. That is 0.373 which is statistically significant because p value is less than 0.05. (0.000<0.05). Therefore, H₀ is rejected and it can be concluded that there is a relationship between service quality and the staff quality factor.

Taking the vehicle quality factor and the service quality, there is a positive correlation of 0.369 which is statistically significant because p value is less than 0.05. (0.000<0.05). Therefore, H₀ is rejected and it can be concluded that there is a relationship between service quality and the vehicle quality factor.

According to the above table 3, there is a positive correlation between service quality and the understanding factor. That is 0.328 which is statistically significant because p value is less than 0.05. (0.000<0.05). Therefore, H₀ is rejected and it can be concluded that there is a relationship between service quality and the understanding factor.

Taking the confidence factor and the service quality, there is a positive correlation of 0.364 which is statistically significant because p value is less than 0.05. (0.000<0.05). Therefore, H₀ is rejected and it can be concluded that there is a relationship between service quality and the confidence factor.

Finally taking the infrastructure quality factor and the service quality. There is a positive correlation of 0.339 which is statistically significant because p value is less than 0.05. (0.000<0.05). therefore, H₀ is rejected and it can be concluded that there is a relationship between service quality and infrastructure quality factor.

C. Effect of Service Quality Dimension on Service Quality of Three-wheeler Transportation

Third objective has been analysed by applying multiple regression model. It is expected to determine significant factors influence on service quality of three-wheeler transportation. To estimate these values a sample is taken the following question developed.

$$y = a + b1x1 + b2x2 + \dots + bpxp$$

y = Variable can be expressed in terms of a constants
 a = Slope
 b = Time the x variable

Results of the model summary are provided by table 4.

TABLE Error! No text of specified style in document.
 MODEL SUMMARIES

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.393 ^a	.155	.140	.74296	1.621

According to the model summary multiple correlation is 0.393. This means that individual factors are having weak association jointly with service quality of three-wheeler transportation. Durbin Watson test statistics is 1.621. This is between the expected standard value that is 1.5 and 2.5 and therefore residuals are independent, and model is appropriate. Jointly effect of individual factors has been analysed by Regression ANOVA. Results are provided in table 5.

TABLE 5
 REGRESSION ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	30.263	5	6.053	10.965	.000 ^a
Residual	165.596	300	.552		
Total	195.859	305			

In the regression ANOVA, probability of F-test statistics is

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	2.398	.169		14.158	.000		
Staff quality	.202	.117	.224	1.726	.085	.167	6.004
Vehicle quality	.184	.128	.218	1.436	.152	.122	8.212
Understanding	-.214	.137	-.246	-1.565	.119	.114	8.771
Confidence	.065	.135	.073	.481	.631	.121	8.256
Infrastructure Quality	.109	.104	.130	1.045	.297	.183	5.465

0.000. This is highly significant at 1% and it says that

individual factors jointly influence on service quality of three-wheeler transportation. Individual effect has been analysed by individual Coefficient and results are given by table 6.

TABLE 6
 INDIVIDUALS EFFECT

With regard to individual coefficient, staff quality is marginally significance with positive Beta values. Individual probability is 0.085. This is marginally significant at 10% with 0.202 individual Beta value. This says that staff quality has a marginal positive effect on service quality of three-wheeler transportation. Vehicle quality, understanding, confidence and infrastructure quality are individually insignificant. Therefore, they have not influence individually on service quality, but they influence jointly in the current situation.

According to standard coefficient of Beta most influence factor is the understanding but in the current situation it has influenced negatively. Second and third factors are respectively staff quality and vehicle quality. They are having positive influence on service quality of three-wheeler transportation.

All the VIF values are less than 10. Therefore, individual factors are not perfectly correlated. This means that they are not having multicollinearity problems. Regression result is more valid. Behaviour of standardized residual is presented by fig. 2.

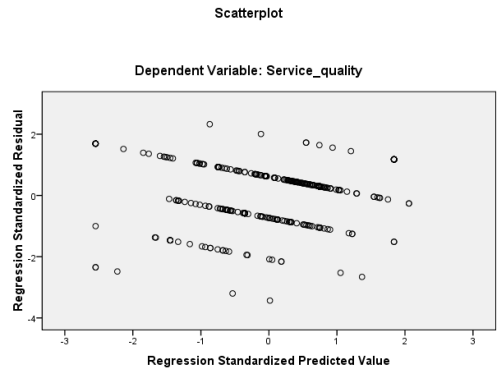


Fig. 2 Residuals Behaviour

In the scatter plot standardized residual have been presented against standardized predicted value. They are randomly distributed without having any predictable pattern. They do not have a funnel shape. Variance of residual is constant. This means that regression model is more valid as it does not have heteroscedasticity problem.

D. Discussions of Research Findings

In the data analysis part in the analysis chapter, demographic data was analysed according to the descriptive statistics. According to the researcher, most of the respondents were in the male category for using three-wheeler service in Kurunegala city which takes a

percentage of 59.5%. Most of the passengers were in 21-30 age category, which is 57.8%, passengers are interested in using three-wheeler service in Kurunegala city. Also, this research found out that most of the employees like to use three-wheeler service. Also, most of the three-wheeler passengers use three-wheelers several times a week. When considering about travel purposes and travel methods, most of the three-wheeler passengers use three-wheeler for work purposes and majority use three-wheeler at park for starting their journey.

In Sri Lanka, three-wheeler service passengers are strongly satisfied with cleanliness of the three-wheelers, availability of fare meter, travel time and speed. The highest number of satisfied responses are given to communication factor, responsiveness and punctuality are rated as the lowest satisfied factor by the respondents. According to the responses, the highest natural rating is given for empathy, age of the driver and comfort of the ride. Majority of the respondents are strongly dissatisfied with the availability of the fare meter, vehicle safety, driver's attitude and reliability.

When considering the passenger satisfaction with gender satisfaction, it is evident that the satisfaction rate is higher in males which takes a percentage of 48.8% than in females in Kurunegala city. When considering the overall satisfaction of both males and females, both genders are satisfied.

In the distribution of three-wheeler passenger satisfaction and age, age is divided in to five categories and among those categories, age between 21 to 30 categories has submitted the highest number of responses. Out of them, 49.7% respondents were satisfied with three-wheeler transport service.

Analysing passenger satisfaction with occupation, employed passengers take the highest responses which is 57.6%. Taking passenger satisfaction with usage of transport in to consideration, several times a week category takes the highest percentage which is 50%. When considering passenger satisfaction and purpose, there are 4 purposes. Among the four purposes, the work category is rated the highest. In passenger satisfaction with method, many passengers choose at park method to start their journey. Out of those responses, most responses are in the satisfied level which takes the percentage of 61.1%

The primary objective of this research is to understand the nature of service quality dimensions and overall service quality. To achieve the primary objective, descriptive statistics is used, and it was identified that the nature of the service quality dimensions is in a moderate level and all the individual service quality factors are in an acceptable level. Furthermore, the service quality dimensions and overall service quality are approximately moderately distributed. According to the result, the primary objective has been achieved.

The secondary objective of this research is to understand the relationship between individual factors and service quality of three-wheeler transportation. To achieve this secondary objective, Pearson Correlation was conducted, and it was identified that all p values of the correlation analysis are highly significant between the individual factors and service quality. Therefore, they are

representing highly significance association between the service quality dimensions and service quality of three-wheeler transportation.

According to Correlation Analysis, staff quality and service quality has the strongest relationship. Vehicle quality takes the second strongest relationship and P value of all the other factors are highly significant between the individual factors. Therefore, there is a positive relationship in understanding confident infrastructure quality with the service quality. According to these outcomes, staff quality of three-wheeler is positively correlated with the service quality dimensions.

The tertiary objective of the research is to determine the significant factors, influencing on service quality of three-wheeler transportation of service quality. To achieve the tertiary objective, Regression Model was applied, and it was identified that individual factors are having a weak association jointly with service quality of three-wheeler transportation. According to the regression ANOVA, it is clear that individual factors jointly influence on service quality of three-wheeler transportation.

IV. CONCLUSION

First, the researcher has identified a broad area which is about three-wheeler transportation in Sri Lanka. Then it was narrowed down to Factors Affecting for the Service Quality of Three-Wheeler Transportation in Kurunegala City. After that quantitative approach was used to measure the factors affecting the service quality. Then collecting data was done through a questionnaire which was distributed online and printed questionnaires to three-wheeler passengers in Kurunegala city. Then fed it into SPSS version 16.0 for analysing purposes. Then a statistical analysis was conducted, Descriptive Statistics, Correlation Analysis and Regression Model have been applied, a reliability test was also conducted to check the internal consistency of variables.

Then conducted a descriptive statistic to achieve the primary objective. To achieve secondary and tertiary objectives, Pearson Correlation and Multiple Regression Models were used respectively. Then it was concluded that the service quality dimensions and overall service quality are approximately normally distributed. According to Pearson Correlation, it was evident that staff quality to service quality has the strongest relationship and other factors too possess a positive relation with service quality. Furthermore, it was also conducted that the staff quality is marginally significant with service quality of three-wheeler transportation.

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Improving Writing Skills in English as a Second Language (ESL) through Feedback, Revising and Multiple Draft Writing: An Action Research

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Abstract - The present study was an action research which attempted to develop writing skills through feedback, revising and multiple draft writing, notions drawn from process approach to teach writing. The sample included ten teacher trainees enrolled in Diploma in Primary Teacher Training Program at a private educational institute. A pre-test and informal interviews were used for need analysis and the take-home writing assignments and students' reflective journals were used for data collection. The intervention was carried out for ten months which included ten take-home assignments which were to be revised based on peer feedback and teacher feedback which led to the production of at least three drafts before the submission of the final draft. The drafts were quantitatively analyzed using analytic rubrics. The comparison of the marks obtained for the first draft and the final draft of each of the ten assignments, the comparison of the marks obtained for the ten final drafts and the comparison of marks obtained for the pre-test and the post-test were made for the purpose of measuring the effectiveness of the intervention. There was gradual but significant improvement of the writing skill in all the writing learners. Accomplishment of the use of grammar, syntax and vocabulary were clearly shown. The development displayed in content also was satisfactory. The style of writing and organizational skills also recorded, though little, some achievement. The implication of the study is that training the writing learner in the use of revising and multiple draft writing based on feedback could be very effective in improving writing skills in ESL learners which will lead to the subsequent quality production of the students' take-home assignments.

Key words -Improving writing skills in English as a second language (ESL), Process approach to teach writing, Portfolio as a strategy to improve writing, Peer feedback and teacher feedback

I. INTRODUCTION

In Sri Lanka, with growing internationalization of higher education around the world, English is widely used as the medium of instruction at tertiary level. Majority of the students enrolled in teacher training programmes face a greater challenge due to the language shift from their first language to English as the medium of instruction.

Writing has always been a difficulty in English education and in the present context also the learners are not an exception. As stated by Richards & Renandya (2002), writing is the most difficult skill for language learners to master. Many teachers do their best but receive little effect; students hardly achieve the

expected levels of mastery. Thus, the ability to write effectively is becoming more and more important in English as a second language (ESL) education.

Pushing the learner through the cognitive processes of writing such as planning, translating, reviewing, and revising has been regarded as crucial in second language writing. Further, as stated by Weigle (2002), training the learner in the use of writing strategies is assuming an increasing role in second language education. The learner can be pushed through the cognitive processes involved in writing if he/she is trained in the use of effective writing strategies such as brainstorming, revising based on feedback, resourcing, multiple drafting.

Thus, improvement of writing skills of the English as a second language (ESL) learner remains a challenge and it needs efforts of both the writing teacher and the learner.

II. RESEARCH OBJECTIVES

The overall purpose of the study is 'Improving writing skills in English as second language through feedback, revising and multiple draft writing' and the research objectives are as follows.

- To identify the difficulties faced by learners in English as a second language (ESL) writing
- To carry out an intervention to develop the skill of writing in English as a second language (ESL)
- To evaluate the success of the intervention and to make recommendations

III. LITERATURE REVIEW

The present study reviewed comprehensive literature related to writing skills and the most relevant conceptual framework has been discussed under three sub themes: process approach to writing, portfolio as a strategy to improve writing skills and feedback as the central element in writing instruction.

A. Process Approach to Writing

Process writing is an approach to writing, where language learners focus on the cognitive processes by which they produce their written products rather than on the products themselves. In the end, learners surely need to and are required to complete their products, yet the writing process itself is stressed more. By focusing on the writing process, learners

to complete their products, yet the writing process itself is stressed more. By focusing on the writing process, learners come to understand themselves more, and find how to work through their own writing as a creator of original ideas. Thus, process writing emphasizes linguistic skills and the cognitive processes involved in writing, such as planning, drafting, revising, and editing rather than linguistic knowledge. (Badger & White, 2000; Brown, 2001).

B. Portfolio as a Strategy to Improve Writing

The present study was an attempt to test whether portfolio writing could be effective in getting the ESL writing learner go through the processes involved in writing: planning, reviewing, revising and multiple drafting. As defined by Barnard & Deyzel (2003), portfolio is a portable, systematic, purposeful collection of work, selected to provide information about attitude, level of development and growth during a given period. It is a powerful visual tool that provides evidence of self-assessment, personal reflections, learning, growth and development and a comprehensive and complex overview of skills. On the other hand, Yang (2003) defined portfolio as a compilation of students' work, which documents their effort, progress and achievement in their learning, and their reflection on the materials negotiated for the portfolio.

Thus, the present study utilized portfolio as a strategy to get the writing learner go through the processes involved in writing and the push through the same was given by introducing brainstorming activities, teacher feedback and peer feedback for the initial drafts written before the final production.

C. Feedback as the Central Element in Writing Instruction

Feedback is a fundamental element of the process approach to teach writing. It can be defined as input from a reader to a writer with the effect of providing information to the writer for revision. In other words, it is the comments, questions, and suggestions a reader gives a writer to produce another draft. Through feedback, the writer learns where he or she has misled or confused the reader by not supplying enough information, illogical organization, lack of development of ideas, or something like inappropriate word-choice or tense. In ESL writing class, both the teacher and peers can be the reader who provide information to the writer for revision and multiple drafting. Thus, teacher feedback and peer feedback are integrated into the intervention plan. Thus, the present study attempted to get the learner revise the text produced so far through the teacher feedback and peer feedback, thus getting the learner revise and produce several drafts before the final product. Revising can be an impossibility if feedback is not given; feedback is supposed to be crucial.

IV. RESEARCH METHODOLOGY

The present study was an action research conducted to improve the skill of writing in ESL learners. It is a form of investigation that can be used by teachers / educators to attempt to solve problems and improve professional practice in their own classrooms. According to O'Brian (2001), action research is

learning by doing : a problem is identified, attempts are made to resolve it, then, see how successful their efforts are and if not satisfied, try again as illustrated in the following diagram.

As proposed by Hopkins (1993), the essentials of the action research design include the following characteristic cycle as illustrated below.

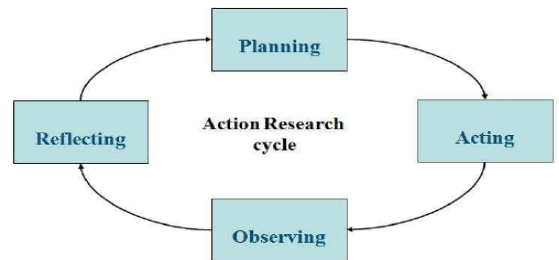


Fig. 1 - Action Research Cycle (Hopkins, 1993)

In the first stage, understanding of a problem is developed and plans are made for intervention. Then, the intervention or action is carried out. During and after intervention, observations are collected in various forms. Data is reflected on and revisions are made on the initial plan; the process is repeated. Thus, action research becomes a very effective tool in the hands of the educator who strives for professionalism, who is enthusiastic to find a solution to a problem he or she has to face in the classroom.

The present study carried out the action research with a sample of ten teacher trainees enrolled in a primary teacher training program in a private educational institute in Sri Lanka. It was conducted over a period of ten months. It utilized multiple data collection instruments. For the realization of the objective 1: to identify the difficulties faced by learners in ESL writing, a pre-test and an informal interview were conducted. For the realization of the objective 2: to carry out an intervention to develop the skill of writing in ESL, the instruments utilized were the take-home writing assignments and reflective journals kept by the students. In realization of the objective 3: to evaluate the success of the intervention and to make recommendations, scores of the first draft and the final draft of each of the ten assignments were compared, the scores of the assignment one and assignment ten were compared and the scores obtained for the pre-test and post-test were compared.

The writing assignments administered during the intervention followed a systematic procedure and it can be presented as below.

TABLE 1
THE PROCEDURE ADOPTED IN ADMINISTERING WRITING ASSIGNMENTS

	Administration of Writing Assignment BRAINSTORMING SESSION Whole Class Activity	
Week 1	Submission of DRAFT ONE TR FEEDBACK Out of Class Activity	Quantitative Analysis Marks out of 10
	↓	
Week 2	Submission of DRAFT TWO SS FEEDBACK In-Class Group Activity	
	↓	
Week 3	Submission of DRAFT THREE TR FEEDBACK –Oral Feedback Out of Class Activity	
	↓	
Week 4	Submission of DRAFT FOUR (final draft) Out of Class Activity	Quantitative Analysis Marks out of 10

The intervention included ten writing assignments. The procedure adopted included a systematic process. On the administration of the writing assignment, a brainstorming session was conducted as a whole class activity with the purpose of idea generation. Students produced the first draft as an out of class activity and submitted for teacher feedback during week one and it was analyzed quantitatively. It was marked out of ten and the rubrics used were as follows: language -4 marks, content – 4 marks and organization – 2 marks. Based on teacher feedback, the students wrote the second draft during the course of week two and the student feedback session was organized as an in-class activity. During week three, students were supposed to produce draft three and teacher’s oral feedback was given with references for resourcing for the students to produce the draft four – the final draft which was quantitatively analyzed, marking it out of ten using the same rubrics used for draft one.

V. NEED ANALYSIS, MEASUREMENT OF THE EFFECTIVENESS OF THE INTERVENTION AND RECOMMENDATIONS

The action research study conducted to improve ESL writing yielded a repertoire of information which led to the insightful understanding of the problem under study. They could be organized and presented as follows.

A. Need Analysis

The analysis of the data collected through the review of students’ writing by conducting a pretest and an informal interviews threw light into two main aspects: the major

difficulties faced by learners in writing in ESL and the reasons for those difficulties.

The main difficulties faced by the ESL writing learner are as follows:

- Lack of ideas has been identified as a major difficulty faced by learners. The content presented in their writing were not adequate.
- The content presented was not organized into appropriate structure.
- Language needed improvement. The use of appropriate structure, tense form, vocabulary have been identified as areas to be improved in language.

The reasons for those difficulties as identified through the analysis of interview could be presented as follows:

- The ESL learners’ misconception about writing as a difficult skill to master could be identified as one of the major reasons for their poor performance. Due to their irrational thoughts, they tend to give up on writing tasks and their lack of perseverance has become a contributing factor for the poor performance in writing.
- The irrational thought about writing as an activity to be completed in few minutes or in one go makes writing an impossibility.
- The learners’ lack of understanding about the writing process and lack of training in the use of strategies in the process of writing have also been identified as contributing factors for poor performance.
- The learners do not possess ideas and facts necessary for pursuing the writing task and the main contributing factor becomes lack of interest in reading.
- The learners’ lack of practice in revising contributes immensely to the poor performance in writing. It becomes the major cause for lack of organization and grammar mistakes the learners commit in the production of the piece of writing.

Thus, in the light of the information gathered on difficulties the ESL writing learners face and the reasons for those difficulties, the intervention was planned and carried out incorporating some effective measures such as feedback, revising and multiple draft writing into it in order to facilitate the cognitive processes involved in writing.

B. Measurement of the Effectiveness of the Intervention

The results of the intervention carried out to improve writing skills in ESL through feedback, revising and multiple draft writing could be presented as follows:

1) Comparison of Marks Obtained for the First Draft (D1) and the Final Draft (D4) of the Ten Take-Home Writing Assignments (THA)

The comparison of the scores of the draft 1 and draft 4 of the take home assignments were compared as a test of the effectiveness of the intervention which basically aimed at

pushing the writing learner through reviewing, revising and multiple drafting using portfolio as a strategy.

TABLE 2
COMPARISON OF MARKS OBTAINED FOR THE FIRST DRAFT (D1) AND THE FINAL DRAFT (D4) OF THE TEN TAKE-HOME WRITING ASSIGNMENTS (THA)

	S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 8	S 9	S 10
	D 1	D 1	D 1	D 1	D 1	D 1	D 1	D 1	D 1	D 1
	D 4	D 4	D 4	D 4	D 4	D 4	D 4	D 4	D 4	D 4
THA 1	3	5	2	4	2	4	4	2	2	2
THA 2	3	5	2	4	2	4	4	2	2	2
THA 3	4	6	3	5	3	5	5	6	4	6
THA 4	4	6	3	5	3	5	5	6	4	6
THA 5	4	6	3	5	3	5	5	6	4	6
THA 6	4	6	3	5	3	5	5	6	4	6
THA 7	6	7	3	5	4	5	6	7	7	9
THA 8	6	7	3	6	3	5	6	8	7	10
THA 9	6	8	4	6	4	6	6	8	7	10
THA 10	7	8	4	6	4	7	6	8	8	10

All the ten ESL writing learners in the sample recorded improvement through multiple drafting which was reflected upon in the comparison of scores obtained for the first draft and the final draft of all the ten assignments.

2) *Comparison of the Marks Obtained for Assignment One-Final Draft (THA1) and Assignment Ten -Final draft (THA10)*

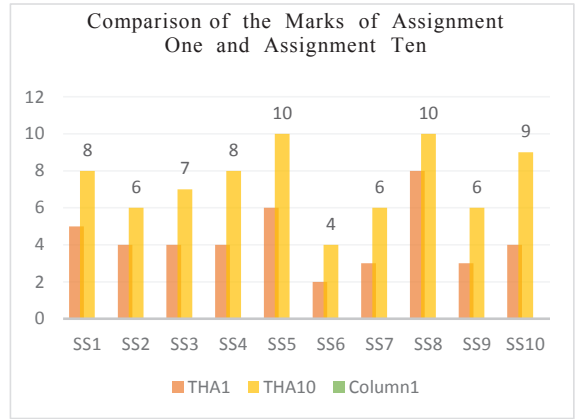


Fig. 2 - Comparison of the Marks Obtained for Assignment One-Final Draft (THA1) and Assignment Ten -Final draft (THA10)

The comparison of the scores obtained by the ESL writing learners for assignment one (THA1) and assignment ten (THA10) proved the improvement students recorded as a result of the intervention carried out to improve their writing. The scores of the assignment one stood as a test of their entry level to the study and the scores of assignments ten was a test of their exit level from the study. The steady improvement showed by all the ten teacher trainees proved the effectiveness of the intervention carried out to improve writing skills through feedback, revising and multiple drafting.

3) *Comparison of the Marks Obtained for the Pre-Test and the Post-Test*

The same pretest which was administered at the outset of the study was used as the post-test to be administered on completion of the intervention and the comparison of the scores of the same could stand as a test of effectiveness of the intervention. The comparison of the scores can be presented graphically as follows.

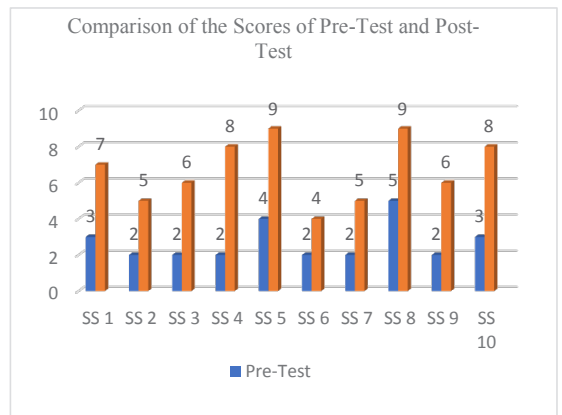


Fig. 3 - Comparison of the Marks Obtained for the Pre-Test and the Post-Test

As illustrated above, the recorded pre-test and post-test scores indicated a significant gap, thus proved the remarkable improvement in the writing skills of all the teacher trainees in the sample which in turn stood as a test of the effectiveness of the intervention made.

Pre-Test		Post-Test	
Leaf	Stem	Leaf	
0,0,0,0,0,0	2		
0,0	3		
0	4		
0	5	0, 0	
	6	0, 0	
	7	0	
	8	0, 0	
	9	0, 0	

Fig. 4 - Comparison of the Marks Obtained for the Pre-Test and the Post-Test

The distribution of scores of the pre-test and post-test as presented in the above stem and leaf plot further explains the improvement of the writing skills recorded by the sample. The modal value of the pretest scores stands only as 20 out of 100 ; the post-test scores records multiple modal values of 50, 60, 80 and 90. The mean value of the pre-test is only 27; the post test records a mean value of 63. Thus, the comparison made between the two scores proved the effectiveness of the intervention carried out to improve writing skills.

4) *Analysis of Students’ Reflective Journals*

Reflective journals kept by the students contributed to the measurement of the effectiveness of the intervention and the reflective thoughts could be coded into the following themes as presented below.

- Idea generation through brainstorming activities in CR on assigning writing task is a motivating factor and it gives the opportunity to gather a repertoire of information on the topic which has been regarded as a very effective strategy by the students.
- Feedback from teachers and peers is guidance and it pushes the learner through the processes of writing: revising and multiple drafting.
- Writing several drafts is crucial in order to produce a good piece of writing.
- Writing differs from mastering other skills for the learner needs to be obsessed with it a lot, taking adequate time for revising, resourcing and redrafting.

VI. RECOMMENDATIONS

Based on the intervention and its measurement of effectiveness the following recommendations could be proposed.

- Brainstorming activities facilitate idea generation in the writing class. They give a steady start to the writing task at hand. The learner becomes motivated for he / she has not been left behind for lack of ideas. Thus, brainstorming activities become crucial in ESL writing class.
- Maintaining a portfolio as a collection of their writing promotes not only good writing but also learner motivation. Since the learners themselves witness their own gradual improvement is highly motivating and the multiple drafting through reviewing and revising makes the writing learner more matured and subsequently it leads to a quality production of the writing task as it provides the learner the opportunity to correct language and organize it better. Further, it leads to shedding the misconception the writing learners hold about writing as an activity to be completed in the first attempt itself. They can be trained in effective writing in which the learner takes time to revise and produce multiple drafts.
- Feedback on the student writing both by the teacher and the peers can be regarded as very effective in getting the ESL writing learner to pursue in multiple drafting. Feedback pushes the learner through the cognitive processes of reviewing, revising and redrafting. Thus, organizing feedback sessions during the course of writing leads to greater facilitation of quality product of writing.

VII. CONCLUSION

Training the writing learner in the use of revising and multiple-draft writing based on feedback by using portfolio as a strategy could be very effective in improving writing skills in ESL learners which will lead to the subsequent quality production of the students’ take-home assignments.

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Gamanak – The Travel Planner with Social Media Mobile Application

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Abstract— Travelling is an immensely popular hobby for most people nowadays since it allows them to be relieved of their stress and enjoy various activities among friends and family. It is a form of adventure which allows them to discover new places, meet people of various ethnicities, learn new languages and relish the beauty of the world. While all these make traveling sound amazing, planning such a journey can turn out to be a very tiresome task which requires a lot of time and effort. The modern world has many solutions for this and out of them, digital solutions come out on top. Most mobile applications developed to overcome this issue require partial or full subscription payments while the free applications are inefficient. The main purpose of this research was to provide a solution to the aforementioned problem by developing a free mobile application facilitated with electronic word of mouth, digital references, predefined mechanisms of selection and added features such as reminders. Interviews and questionnaires were used as the main research methodology to gather information from the targeted users. The findings of the study indicated that a majority of the target population would prefer to use an application which uses social media and electronic word of mouth to convey travel details. Overall, it will promote the tourist industry in the country especially after the COVID-19 pandemic.

Keywords— Travel app, Electronic Word of Mouth, API, Social Media, Travel Planner.

I. INTRODUCTION

Social media has made a huge impact for every industry. Today, the Traditional Word of Mouth has become the Electronic Word of Mouth. This has made it possible to believe by seeing rather than believing what is heard. Travel is also used as a hobby and to relieve stress in people who lead busy lives. The most important thing when making a trip is to plan it and tourist will have to bear some cost for this. There must be justice for the cost and the time it takes. Social media can be linked to travel planning and a mobile application can solve this problem. This research shows that “Gamanak” mobile application helps traveller to use social media as a way to successfully plan and make their trip effective. It also automatically suggests the places that the traveller wants during the trip and also reminds the user the meal on time.

II. LITERATURE REVIEW

Phones were invented as a result of the need for communication [1]. Sweden introduced mobile phones with portability in the early 1980s [2]. In modern times, the mobile phone has become an integral part of human life. Mobile phone use has become a common feature in the world from young children to adults. In present, 3.5 billion people use mobile phones, and Statista estimates that by 2021 it will be 3.8 billion. The Apple iPhone was able to revolutionize the evolution of mobile phone. The smartphone was introduced 15 years before the introduction of the Apple iPhone. Called the ‘Simon Personal Communicator’, it was created by IBM [3]. With the introduction of Apple iPhone, smartphones become popular. Designed just for making calls, the phone has now become a multi-functional device. Smartphone is an advanced device that can perform similar functions to a computer. Applications were also created for smartphones for variety of functions, such as a computer.

In today’s fast-paced world of technology, it is common to use technology in almost every activity. Technology has had a huge impact not only on people’s lives but also on businesses. It can be seen through the internet that this technology is also involved in the tourism industry. Many websites and mobile applications for the advancement of the tourism industry can be found on the internet. People who lead a very busy life spend very little time with their loved ones. Although different strategies are used to relieve busyness and stress, among them, traveling is one of them. Lack of proper planning about the trip can be ineffective. Tourists have to spend some time to prepare such a plan. There are many remedies on the internet to minimize that extra time. As well as tourists can download mobile applications to plan a trip.

The community can see the distance travelled from one place to another via Google Maps as well as the time taken by each mode of travel. For example, the shortest route from Colombo to Galle is 125km [4] and it is very clear that even other alternative routes can be taken through different modes of travel. Today, social media has a huge impact on every industry. Many of the beliefs that exist in society are things that have existed through word of mouth. Word of mouth has the potential to influence the whole world. As word of mouth has become electronic [5], humans are using word of mouth online. It is most trustworthy today than it was in past

because of the ability to prove its precision through pictures and videos. It appears through social media and is a kind of marketing method that exists in the society today. According to EMarketer, in terms of marketing in Asia, by 2020, 75.2% [6] of all social media will be marketed through Facebook, and it appears that the economy can be built through free social networks. It has been indicated under Figure 1.

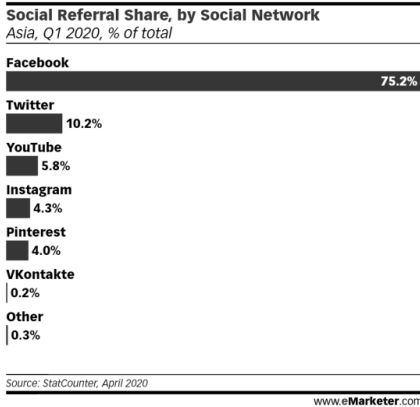


Figure 1 - Social Referral Share, by Social Network [6].

According to a survey conducted by the Sri Lanka Tourism Development Authority in 2019 and 2020, 507,311 [7] foreigners visited Sri Lanka from January to July, a decline due to effect of the outbreak of COVID-19. It presents under Figure 2.

Month	2019	2020	% change 2019/20
January	244,239	228,434	(6.5)
February	252,033	207,507	(17.7)
March	244,328	71,370	(70.8)
April	166,975	0	-
May	37,802	0	-
June	63,072	0	-
July	115,701	0	-
August	143,587		
September	108,575		
October	118,743		
November	176,984		
December	241,663		
Total (Up to July)	1,124,150	507,311	(49.7)
Total	1,913,702		

Figure 2 - Arrival Report Summary – SLTDA [7].

III. RESEARCH QUESTIONS

1. How does social media affect the tourism industry?
2. How can a mobile application help to plan a trip due to human’s busy life?
3. How to avoid forgetting meals during the trip?

IV. METHODOLOGY

A. Planning

Travel can be seen today as one of the methods used to relieve stress [8]. seen today as one of the methods used to relieve stress. Many tourists are reluctant to travel here due to the time taken to plan. There is a need to make the trip effective as there are costs involved. This research discusses the creation of a mobile application to utilize the concept of social media as a solution to plan and make the trip effective.

This research has shown how the electronic word of mouth can be used as a social media tool for the tourism industry, as well as a smart phone application that can help community make an effective trip and save time in their busy lives. According to the Sri Lanka Tourism Development Authority [6], the tourism industry in Sri Lanka is one of the most sought-after destination for both locals and foreigners.

Influencers on social media or tourists upload photos of places they have visited. Responses to them and seeing them saw more people going to those places and uploading photos. It was revealed that this will have an impact on the tourism industry through social media.

B. Requirement gathering and Analysis

Travellers and non-travellers above the age of 18 and of both genders were the intended target population of this application. The sampling frame included the whole target population since simple random sampling was conducted. The research methodology for requirement gathering consisted of interviews and questionnaires to gather data regarding the likes and dislikes of each individual.

After surfing and conferring the data collected in this way, authors were able to identify user expectations.

C. Design

The Authors hope to create a travel mobile application for travellers through this article, which will provide a great service to the tourism industry as well as travellers. Simply put, this mobile application is a social media application for travellers. Below is the Figure 3 presents flowchart of the mobile application.

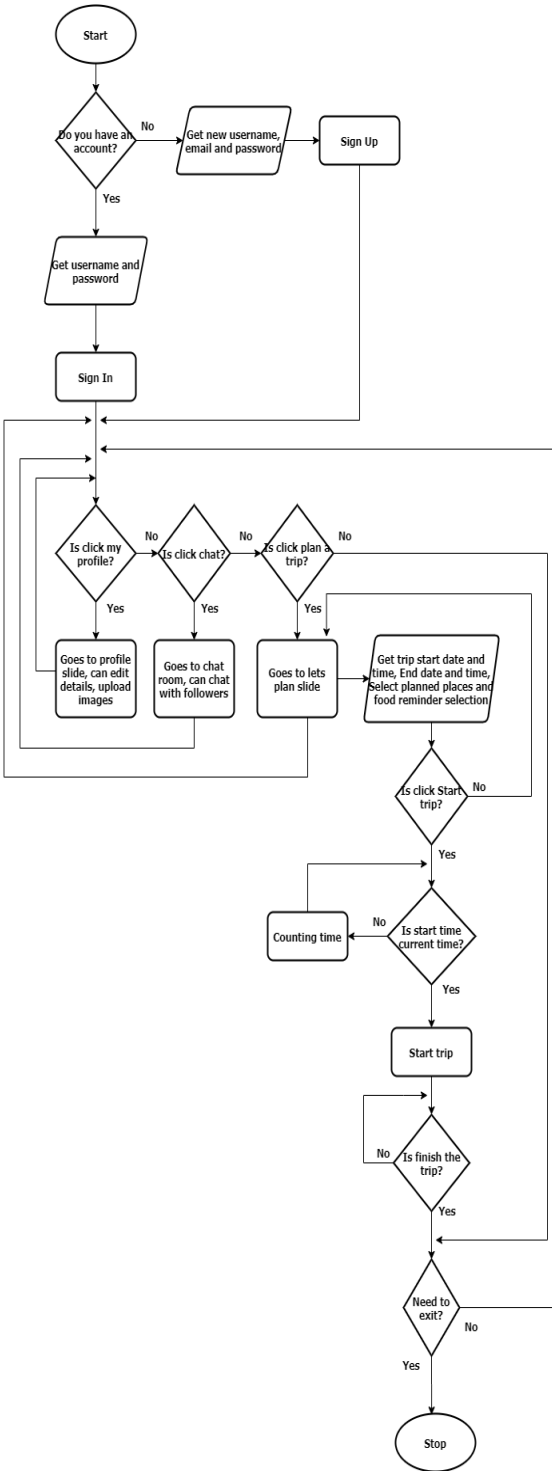


Figure 3 - Flowchart of Mobile Application

Authors hope to create this mobile application to minimize the time it takes to plan a trip and to improve the tourism industry. First of all, after installing the application on the phone, the details of how this application works will be presented. The presentation of this will be as in the flowchart above. This mobile application allows users to register for free and plan a trip. When describing this mobile application, the user can register through the email address and see the pictures of other places visited by tourists. It is displayed on the user's home slide. It has been indicated under Figure 4.

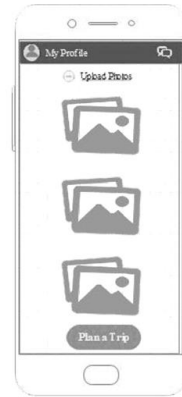


Figure 4 - Home Slide - Mobile Mockup

Authors hope to give this application a function which allows every user to like any uploaded picture. Images uploaded by users are displayed on other users' home slides. Those images can give travellers who want to visit some idea of the places they plan to visit and this will help make the trip more effective.

Authors also hope to add the most popular post feature to this application and for that, the reversed Bubblesort algorithm will be used to present the most popular post. Clicking on that button will take to the user's profile, where the user will be able to upload his/her data as well as images and edit data. It presents under Figure 5.

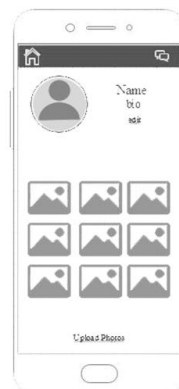


Figure 5 - Profile Slide - Mobile Application

However, authors will design this mobile application to save the user time as well as make the user’s visit more efficient through various special features. Another feature to be included is the ability to plan the trip with a single button. The user can access the plan a trip slide by clicking on the plan a trip button as shown in Figure 4-Home slide – Mobile Mock-up.

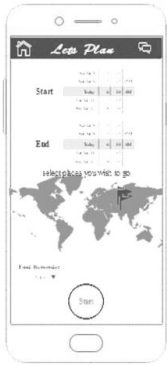


Figure 6 - Plan a Trip Slide - Mobile Mockup

As shown in Figure 6-plan a trip slide – Mobile Mock-up, the user is asked for some information in order to plan the trip. First and foremost, plan the start date and end date of the trip. Also, the start time and end time should be given by the user. The authors hope to enable this application function so that the user can mark the places they want to see using the Maps API. It is assumed that this will enable the user to use the phone’s touch screen facilities such as zoom, pinch. Eating right is a hallmark of a healthy person. User may miss it on time while travelling. This application reminds the traveller to get meals on time and reminds the relevant time automatically. Authors hope to add to this application the ability to change those times at the user’s discretion. After completing this information and after clicking the Start button, the application will confirm if the given start date and time are the same as the current date and time. And if it is the same, then the trip will start. If unequal, the time count is until the future date. It notifies the user at start-up time by a notification.



Figure 7 - Through Travelling Slide - Mobile Mockup

After the trip starts, the user can see his whereabouts and destinations while traveling. Authors hope to automatically suggest and customize the buttons where the user thinks they want to be near the user’s location. It has been indicated under Figure 7. All the nearby places are shown on the map given via google maps. Authors hope to use an API for the map used for this application.

Food reminders also take place during the trip. Hotels and rooms suitable for overnight stays are automatically suggested for a few days’ journey and authors hope to add the convenience of chatting with hotel and room owners through this application through the chat room.

D. Implementation

This application is designed according to the drawn Flowchart and Mock-ups. Mobile application requires an interface as well as a database to store data. Currently, Flutter is used to create mobile application for creating interfaces, and database runs over the internet. This uses Firebase.

E. Testing

Authors hope to test this research in response to the mobile application being made available to several people at once. It intends to make changes in the application with that response.

V. RESULTS AND DESCUSSION

This travel application is intended to be a social media for tourists as well as for advancement of the tourism industry. The traditional Word of Mouth today has become the Electronic Word of Mouth and influencer marketing has taken off. Influencer marketing is done by person who has large followers [9]. It is “the art and science of engaging people who are influential online to share brand messaging their audiences in the form of sponsored content” [10].

Electronic Word of Mouth allows another traveller to see a place he/she has visited by uploading it to this application through an image rather than telling another user who sees it. The idea that the user gets from it is more of an image than a word. The idea of going to that place is effective only after the user discovers that is a good place to visit. This application will help the tourists as well as the tourism industry.

A. Advantages to User

This application is free and will help the busy community as well as frequent travellers. Community can use this application to plan a moment away from their busy lives and travel with loved ones. This application allows the user to visit desired location and to see and understand the location visited by another user. User

satisfactions can be maximized by automatically suggesting locations that the user deems necessary during the journey from the start of the trip to the end. Also, forgetting about meals during the trip will no longer happen due to this application. It also has the ability to remind the user of their own meal schedule according to the to avoid skipping meals. If user traveling for a few days, user can book resting information with hotels and room owners through this application.

B. Advantages to Tourism Industry

Using this application, locals as well as foreigners can clearly identify the suitable places to visit. Accommodation companies such as hotels can register through this application to market their businesses. It also gives the tourism industry the ability to do influencer marketing.

Even in large companies, marketing is done extensively through social media [11]. Today, most travel applications can be downloaded online, but most require payment to get the most out of them. But this application is full of capabilities that allows user to get all benefits for free. Also, a special feature of this application is the meal reminder feature which is not available in other travel applications. Authors also hope to provide the user with the ability to customize it. Authors believe that this application will be able to make an impact on the tourism industry by using influencer marketing. Another feature here is that it automatically suggests the places that the user thinks user want while traveling.

VI. CONCLUSION

The technological advancement in world today has had a huge impact on every industry. Travel is one of the various strategies used to relieve stress. Although community tend to travel to relieve the stress of a busy society, they often have to devote some time to planning and travel, which can often lead to the loss of the idea of travelling. The travel application authors hope to create from this research will enable the user to plan an effective trip without wasting time. The research shows that the impact of social media on tourism can be demonstrated and this application can be used to develop the tourism industry. The main purpose of this is to create a mobile application that will help the traveller to travel effectively using the Electronic Word of Mouth.

VII. ACKNOWLEDGEMENT

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Pilot Study, Antihypertensive Prescription Analysis of Hypertensive Patients at Community Pharmacy Outlet; Sri Lankan Perspectives

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Abstract — Prescribing pattern of antihypertensive medicines is much concerned in the context of treating this disease hypertension. The main objective was to determine prescribing patterns of antihypertensive medicines. Hundred prescriptions were collected from one community pharmacy outlet for three days. Prescriptions of hypertensive patients were analysed by using Microsoft Excel. Out of hundred prescriptions, 57% accounted for female and 43% for male. According to the results, antihypertensive drugs were widely prescribed for patients (54%) above 60 years, as expected following 45% of patients within 20-60 years age category. But, only one patient below 20 years of age (1%) was prescribed with anti-hypertensives. Out of all the prescribed anti-hypertensives, 59% accounted for Angiotensin Receptor Blockers (ARBs) & Angiotensin Converting Enzyme Inhibitors (ACEIs) followed by Calcium Channel Blockers (CCB) (16%), Diuretics (13%), β -Blockers (5%) and others (Alpha blockers, Potassium channel blockers, α & β blockers & Alpha-2 adrenergic receptor agonists) (7%) respectively. Losartan was the highly prescribed ACEI and ARBs (85%) followed by HCT (Diuretic) (75%) Diltiazem and Nifedipine (CCB) (36% equally) and Bisoprolol (β -Blocker) (57%) as highly prescribed anti-hypertensives under each category. Study concluded that, ACEIs and ARBs were the highly prescribed drug category following the drug Losartan. 1% from the total prescriptions were accounted for prescribing Nifedipine (CCB) only for the age below 20. But there were antihypertensive drug combinations prescribed for the 20-60 and above 60 age categories rather than prescribing a single antihypertensive. Further recommended to analyse the types of anti-hypertensive combinations among each age category.

Keywords— Community Pharmacy; Hypertension; Anti-hypertensives

I. INTRODUCTION

Blood pressure is the force exerted by circulating blood against the walls of the body's arteries and the major blood vessels in the body. Hypertension, also known as high or elevated blood pressure, is a condition in which the blood vessels have persistently raised pressure (WHO, Hypertension, 2019). According to the estimation of World Health Organization (WHO), 1.13 billion people worldwide have hypertension and most of them are living in low and middle-income countries. Since hypertension is a major cause of premature death throughout the world (WHO, Hypertension, 2019), it is a serious medical condition that significantly increases the risk of occurring heart, brain, kidney and other diseases. This is becoming one of the most

dangerous non - infectious diseases in Sri Lanka as well (WHO, Hypertension, 2019). Considering risk factors there are modifiable risk factors that include unhealthy diets (excessive salt consumption, a diet high in saturated fat and trans fats, low intake of fruits and vegetables), physical inactivity, consumption of tobacco and alcohol, as well as being overweight or obese. Non-modifiable risk factors include a family history of hypertension, age, gender and co-existing diseases such as diabetes or kidney disease. (WHO, Hypertension, 2019).

According to the research carried out on prescribing patterns of antihypertensive drugs taken by geriatric patients in an out-patient department at Rohini Super Speciality Hospital, India. Out of 100 prescriptions, 72% of the patients were in the age group of 65-67 years, followed by 26% in 68-70 years and 2% who were >70 years This was found out to be higher in men 69% than in women, which was 31% (Mateti *et al.*, 2012). In addition, the most commonly prescribed drug classes involved were Calcium Channel Blockers (CCBs) 37% followed by Angiotensin II receptor antagonists 21% and Anti-hypertensive drug combinations among hypertensive patients were seen among this community and this practice positively impacted on the overall control of the blood pressure. It was Amlodipine (38%), the most commonly prescribed monotherapy, and the most common two drug combination therapy was Amlodipine + Atenolol 7%. (Mateti *et al.*, 2012). The research study "Who is using antihypertensive drugs? A prescription analysis from Finland" carried out by Wallenius *et al.*, in 1996 has suggested that the choice of antihypertensive drugs depends on the age and gender of a patient. According to the study results, 23% of the men received a drug belonging to the hypotensive group and nearly half 50% were prescribed with a beta blocking agent, and 27% with a diuretic (Wallenius *et al.*, 1996). Among women the distribution of the different drug groups was more even: more than half the women (55%) were prescribed with antihypertensives while beta blocking agents and diuretics were prescribed for 43% and 44 %, respectively (Wallenius *et al.*, 1996). According to the research which was conducted in a teaching hospital Lagos, Nigeria 2016 on 200 patients, 5 (2.5%) were on monotherapy and 195 (97.5%) were on combination therapy. The various classes of antihypertensive drugs prescribed were Diuretics 128 (64.0%), Beta-blockers 126 (63.0%), Calcium channel blockers 106 (53.0%), Angiotensin-converting enzymes inhibitors 103 (51.5%), Angiotensin receptor blockers 33 (16.5%), Alpha blockers 9

(4.5%), and fixed drug combinations 2 (1.0%) (Bakare *et al.*, 2016).

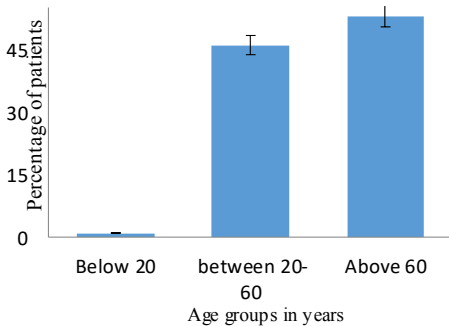
Prescribing pattern of antihypertensive drugs is much alarmed in the context of treating hypertension. The main objective was to determine prescribing patterns of antihypertensive drugs in a selected population as a pilot study. Besides, the study will access the determination of most commonly prescribed antihypertensive among drug categories and the correlation between ages, gender, with hypertension. The explorations will be assistive for the further studies which correlated with hypertension.

II. MATERIALS AND METHODS

Hundred prescriptions were collected from a community pharmacy at Mahagama on 17th, 18th and 19th of February 2020, from 9am to 5pm. All the records were analysed by using Microsoft Excel according to the age group and gender of the patients. Age group categorization was done according to three age groups as; first group within the ages below 20 years, second group between the ages of 20-60, third group within ages above 60. The most frequently prescribed medication for hypertension were identified and all the results were analysed in a graphical way with further descriptive information.

III. RESULTS

Our results show that out of hundred prescriptions of hypertensive patients 57% were female and 43% were male. Prescription data was analysed as per the age categories and data were categorized into three age groups. They were age below 20, ages between 20-60 and ages above 60. According to the results, antihypertensive drugs written prescriptions



were highly prescribed for patients (54%) above 60 years, as expected following 45% of patients within 20-60 years age category. one patient (1%) was prescribed with anti-hypertensives below age 20. The mentioned data are depicted in the figure 1.

Figure 1 shows the age-based classification of the antihypertensive prescriptions used in our study. Data shows that most of the prescriptions belongs to above 60 age group and lowest found with the below 20 age group

We further analysed our data to find out the qualitative and quantitative difference of drug groups in the given prescriptions in this study. Mostly prescribed drug group was identified as ACE inhibitors and receptor blockers (59%) and

16% of the analysed antihypertensive prescriptions were identified from calcium channel blocker group. Diuretic prescriptions were 13%. β -Blockers were the least prescribed drug category in our study and it is 5%. Other drugs like alpha blockers and potassium channel blockers is 7%. Details are given in figure 2

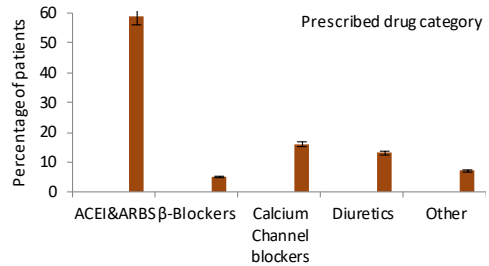


Figure 2 shows qualitative and quantitative prescription analysis of our study group. Prescription collected from the study place were further analysed for qualitative and quantitative calculations. This study shows that most prescribed antihypertensive drug category was ACE inhibitors and ACE receptor blockers and beta blockers; calcium channel blockers and diuretics are the next common drugs groups identified.

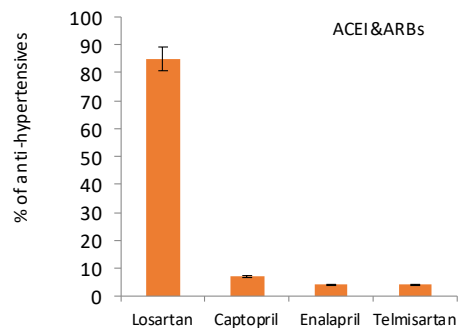
Prescriptions with Monotherapy or multiple therapy

Our research also identified that majority of antihypertensive prescriptions are (67%) monotherapy and only 33% were on combination therapy. Combination patterns of the antihypertensive drugs were further analysed and found that losartan + HCT and losartan + amlodipine (18%, equally) were the commonly used combination therapies. Most common three drug combination therapy was HCT+ losartan+ carvedilol (25%). This research has shown that combined antihypertensive drugs are more commoner than monotherapy for the patients between 20-60 years and above 60 years (figure 3)

Considering the most commonly used antihypertensive drugs among mentioned categories, Losartan was the highly prescribed ACEI and ARBs 85% (fig. 3a) followed by HCT 75% (diuretics, fig. 3b), diltiazem and nifedipine which are 36% (CCBs, fig. 3c) and bisoprolol 57% (β -blockers, fig. 3d)

Detailed analysis of the antihypertensive therapy

3a



3b

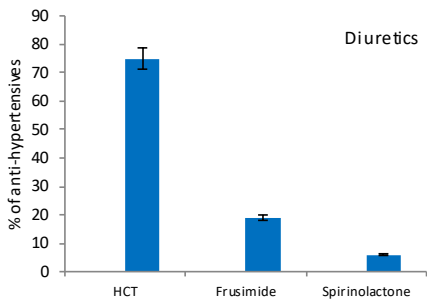
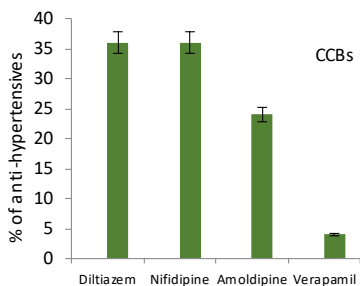


Figure 3a, 3b, 3c and 3d shows that qualitative prescription analysis of ACEI/ARBs blocker (3a), diuretic analysis (3b) CCB analysis (3c) and beta blocker analysis (3d) therapy in the prescription for hypertension in our study group. Data shows that most common drug are losartan, HCT Diltiazem and Bisoprolol in ACEI/ ARBs, Diuretics, CCB, and beta blockers respectively.

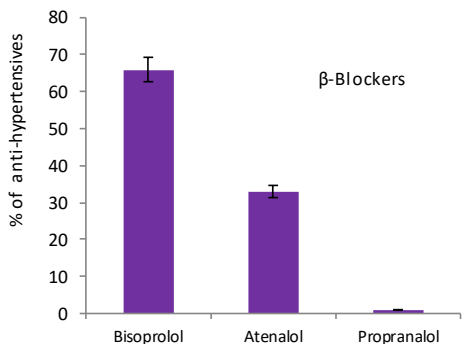
IV DISCUSSION

Hypertension is frequently seen among people of Sri Lanka. One of our objectives was to find out the different types of prescribing patterns of antihypertensive drugs. Hundred prescriptions were collected from a community pharmacy at Mahagama and all the information of prescriptions were analyzed according to the age groups, gender and prescribed antihypertensive drugs. Age groups were categorized as; below 20 years, between 20- 60 years and above 60 years. According to the prescribed antihypertensive drugs there were variety of categories of antihypertensive drugs. ACEIs and ARBs (ACEI prevents an enzyme from producing angiotensin II which is a potent vasoconstrictor whereas ARBs block the effect of angiotensin II on its receptor), β -Blockers (Beta Adrenergic Receptor Blocking Agents), CCBs (Reduce influx of calcium ions into cardiac cells), Diuretics (increased production of urine) and other drugs (Alpha blockers, Potassium Channel Blockers, α and β Blockers) were the different categories of drugs. In the present study, hypertensive patients were classified based on their gender. More than one half of the study population was female (57%). Our study showed totally opposite findings of Mateti *et al.*, indicating that hypertension was more common in men than women. It was found to be high as 54% in the age group above 60 years and low as 1% in the age group below 20. In contrast, similar results were obtained by the same group, Mateti *et al.*, and found that 72% of geriatric patient were prescribed with antihypertensive drugs. According to the British hypertensive society guidelines, there are four main different categories of antihypertensive drugs. ARBs & ACEIs, β - Blockers, CCBs and Diuretics. We also found that, ARBs & ACEIs (59%) were identified as the most frequently prescribed antihypertensive drug category followed by CCBs (16%), Diuretics (13%), and β -Blockers (5%). The obtained results were different from studies of Bakare *et al.*, and Wallenius *et al.*, Wallenius *et al.*, had obtained β - Blockers as the most frequently prescribed antihypertensive drug category (>50%).

3c



3d



Our finding on 67% were on monotherapy and 33% were on combination therapy were compared with the study of Bakare *et al.*, in which out of 200 patients, and identified different results (2.5% were on monotherapy and 97.5% were on combination therapy). Present study has shown Losartan (75%) as the most commonly prescribed antihypertensive medicine. But it was Amlodipine (38%) in the study of Mateti *et al.* In this study, Losartan+HCT and Losartan+Amlodipine (18%) were the commonly used two drug combination therapy while most common two drug combination therapy and the study of Mateti *et al.* was Amlodipine + Atenolol 7%. This research was based on 100 prescriptions at community pharmacy settings, under the categories of gender, age groups and anti-hypertensive drug categories. This was done to get a

better understanding of the risk factors and risky groups. This study was useful to observe the trends in the treatment, to get an idea on the gender and age category which tends more to suffer from hypertension and to be familiarized with antihypertensive drugs which are more commonly prescribed among patients with hypertension in the selected community. This study can be further developed to study the reasons for the occurrence of hypertension and preventive measures.

IV. CONCLUSION

Considering the drug categories, Angiotensin Converting Enzyme Inhibitors (ACEIs) and Angiotensin Receptor Blockers (ARBs) are highly prescribed for hypertension and

Losartan is the highly prescribed drug among the drugs belonging to this category. The research has shown that combined antihypertensives are more common than monotherapy for the patients between 20-60 years and above 60 years.

V. RECOMMENDATION

This study can be further developed to analyse the different types of antihypertensive combinations among each age groups.

VI. ACKNOWLEDGMENT

Sincere gratitude to the Dean and the staff of the Faculty of Health Sciences for their enormous contribution and support to do this undergraduate research.

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Potential Pathophysiology Through High Gonadal Hormone Profile and Peripheral Insulin Resistance, Circumventing IFN γ Effects in Women With Polycystic Ovary Syndrome

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Heterogeneous Polycystic ovary syndrome (PCOS) is a low grade inflammatory diseases common with many of the young female and strongly associated with peripheral insulin resistance. Our study focused on investigating the effects of interferon gamma (IFN γ) in control of IR in obese PCOS patients with matched control. PCOS patients diagnosed by Rotterdam criteria and BMI matched controls were checked for Fasting insulin and IFN γ , FSH, LH, prolactin, testosterone, triglycerides and glucose levels and IR was calculated by Homeostasis Model Assessment (HOMA-IR), Quantitative Insulin Sensitivity Check Index (QUICKI) and McAuley (McA) index. Fasting glucose, insulin, and IR by QUICKI, HOMA-IR and McA is higher in obese PCOS in compared to control. High serum testosterone, LH, and FSH levels were also observed in women with PCOS. But IFN γ is not statistically significant and not correlated significantly with fasting insulin ($\rho = -0.004$), HOMA-IR ($\rho = -0.02$), QUICKI ($\rho = -0.11$) or McA ($\rho = -0.15$) in obese women with PCOS. We suggest that development of peripheral insulin resistance in PCOS is not through the mediation of IFN γ . Further studies are needed to prove the suggested mechanism and to develop drugs for reversing PCOS pathology.

Key words Pro-inflammatory cytokines, PCOS syndrome and peripheral Insulin resistance

I. INTRODUCTION

PCOS is one of the most common endocrine disorders in women of reproductive age and cause of and leading cause for infertility and hirsutism (1). In the latest finding in 2020, central obesity has been identified as a one of the risk factor in PCOS patient (2). Azziz *et al* found the exponential growth of the PCOS prevalence in population of reproductive aged women in United States (3). Population statistics in Sri Lankan patients had also found out in 3030 individuals, that the prevalence of PCOS is similar to above finding among women aged 15-39 years (4). PCOS is strong and it has been identified that the obese PCOS patients

showing high insulin resistance (IR) and fasting insulin (FI) levels (5). It has been identified that the obese women with PCOS show greater IR and higher FI levels (6). It has been observed that hyperinsulinemia associated with IR linked to all the features of this syndrome like hyperandrogenism, reproductive disorders (irregular cycles, infertility), acne, hirsutism and metabolic disturbances (7).

There is no standard treatment plan to treat these individuals. Various options have been tried to improve the signs and symptoms. It has been hypothesized that Insulin sensitizing agents like metformin have impact on IR and improve endocrine, metabolic and reproductive abnormalities of women with PCOS and have numerous beneficial effects (6). Another research group had identified the relationship between IR and PCOS syndrome But the practice of treating all women with PCOS with these agents has not been justified (8). At the same time the mechanism underlying the beneficial effects of such medications in the treatment of PCOS remains incompletely understood.

Studies have revealed that the serum levels of C reactive protein (CRP), interleukin 6 (IL-6) and tumor necrosis factor (TNF α) are increased due to inflammatory mediation in PCOS (9,10). This important finding reflects a chronic low grade inflammatory process in this syndrome. The current study is based on Interferon gamma (IFN- γ) which is a pro-inflammatory cytokine. It is reported that IFN- γ is actively involved in almost all phases of immune and chronic inflammatory disorders (11). In addition, this cytokine is related to the development of IR in obesity (12). Another research team that the stimulated production of IFN γ is significantly decreased in women with PCOS, irrespective of BMI *n-vitro* study, (13). Our research study focus on the potential mechanism or a role of pro-inflammatory marker, IFN γ in the development process of IR which may

be used in the new drug leads in designing and development for PCOS. Therefore this study was designed to see the potential relationship between IFN γ and peripheral IR in obese women with polycystic ovary syndrome.

II. MATERIALS AND METHODS

A descriptive cross sectional study was carried out for 12 months and the research was approved by the accredited Ethical Review Committee. Consecutive affected obese women (BMI \geq 30kg/m²) with PCOS, enrolled at specialist clinics in two Teaching Hospitals, from April to August, were invited for the study. Concurrently, BMI matched asymptomatic, un-medicated, menstruating women were recruited as controls from gynaecology clinics and among the staff members of two hospitals. PCOS was excluded among control individuals by doing biochemical and ultrasound testing. Written informed consent was obtained from all volunteers. Women who were diagnosed to have PCOS by the clinicians using the 2003 Rotterdam criteria were recruited (Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group, 2004). Diagnosis was established clinically, biochemically and radiologically, and confirmed when two out three of the following features were present: Oligomenorrhea (Cycles lasting longer than 35 days) or amenorrhea (Less than two cycles in the past six months), clinical signs of hyperandrogenism with a Ferriman – Gallway (FG) score \geq 8 and polycystic ovaries. (at least one ovary with at least 12 follicles of a diameter of 2-9mm or a volume >10ml). woman with hyperprolactinaemia and those taking corticosteroid, antiepileptic or antipsychotic drugs or hormonal contraception or suffering from acute illness and those currently pregnant were excluded. The degree of hirsutism was determined by the modified FG score. Body mass index (BMI) was calculated as weight/ (height)² in (kg/m²). Presence of acanthosis nigricans was determined by examining the neck, axillae, face, chest and knuckles. Groin and vulva were excluded due to common difficulty in clinical differentiation from intertrigo. Transabdominal ultrasound examinations, in unmarried women, and transvaginal ultrasounds, in married women, were performed either by a V.O.G/Senior registrar or Registrar to measure number of follicles and the ovarian volume in the amenorrhoeic phase of each individual. Serum samples were analyzed for fasting sugar (enzymatic colorimetric assay), insulin by ELISA,

triglycerides (enzymatic colorimetric assay, GPO-POD method) and IFN γ (ELISA). Hormonal analysis (FSH, LH, prolactin done by Radio immunoassay & testosterone, by ELISA) of each individual was done. Radio-immuno assay was used to measure the FSH, LH, Prolactin levels and ELISA technique for the assessment of testosterone level

Insulin resistance.

IR was calculated using indirect methods for the assessment of insulin resistance. The indices used were Homeostasis Model Assessment (28), Quantitative Insulin Sensitivity Check Index (29) and McAuley index (30).

Patients were considered as insulin resistant when $McA \leq 5.8$, $HOMA \geq 2.6$, $QUICKI \leq 0.33$ and fasting insulin $\geq 12\mu\text{IU/ml}$ (Hettihewa *et al.*, 2006). The equations used for calculation are listed below. Homeostasis Model Assessment:-

$$(HOMA-IR) = \frac{\text{Fasting serum insulin } (\mu\text{U/ml}) \times \text{Fasting serum glucose (mmol/L)}}{22.5}$$

Quantitative insulin sensitivity check index:-

$$QUICKI = \frac{1}{\log(\text{fasting insulin}) + \log(\text{fasting glucose in mg/dl})}$$

McAuley index-(McA):-

$$McA = \exp[2.63 - 0.28 \ln(\text{insulin in } \mu\text{U/L}) - 0.31 \ln(\text{triglycerides in mmol/L})]$$

III STATISTICAL ANALYSIS

Data were analyzed using the Statistical Package for Social Sciences (SPSS), v for windows and Microcal Origin, version 6.0. Pattern of distribution was checked with Prism graph pad-4. Results were expressed as mean \pm SD or median with Inter Quartile Range (IQR). Parametric continuous data such as age, BMI, fasting insulin, triglycerides, LH, FSH, prolactin, testosterone, LH/FSH ratio and QUICKI of women with PCOS and matched controls were tested using unpaired t-test. Non parametric continuous data such as interferon gamma, fasting serum glucose, HOMA, McAuley and non parametric ordinal data such as FG score were analyzed with the use of Mann-Whitney U – test. Correlation between IR and serum IFN γ level among cases was analyzed with Spearman's rank correlation test and coefficient (ρ) was calculated. It gave the numerical expression for the measure of correlation. The value indicated the magnitude of correlation and the sign denoted its direction. Multiple linear regression analysis was used to see the effects of covariates. P-values < 0.05 were considered significant in all data.

IV RESULTS

Table 1

Basic Characteristics of The Study Group

Character	Women with PCOS	Controls	p-value
Age	27.7 ± 5.9 *	34.2 ± 5.8 *	< 0.001
BMI (kg/m ²)	32.0 ± 1.9 *	31.7 ± 1.5 *	NS
FG score	9.5 (6.5-12)**	3.0 (2-3)**	< 0.0001

Table 1 Basic clinical characteristics of women with PCOS and the controls. There was no significant difference in mean BMI between the two groups. Mean ± SD, analyzed with unpaired t-test and the Median (IQR), analyzed with Mann-Whitney U-test

As per the above findings, acanthosis nigricans was present in 20 (71.4%) out of 28 women with PCOS but none of the control women had this clinical feature. Table 1 shows the basic clinical characteristics of group with PCOS and the control

The mean fasting insulin concentration in women with PCOS was more than double the value of controls ($p < 0.0001$), but the difference in fasting blood glucose was not statistically significant. Significantly high serum levels of both LH and FSH hormones were observed in PCOS group but the LH/FSH ratios were not significantly different. Obese PCOS women were found to have significantly higher total serum testosterone levels than appropriate controls ($p < 0.0001$). The median IFN γ values were not statistically different between the two groups (table 2).

Table 2 Insulin Resistance By HOMA -IR, QUICKI And McAuley Indices In PCOS And Control Group

	HOMA-IR	QUICKI	McAuley	
Women with PCOS	11.2(6.2-16.1)**	0.28 ± 0.02 *	3.7(3.5-4.4)**	
Controls	4.6(3.5-7.0)**	0.30 ± 0.02 *	5.1(4.5-5.4)**	
p value	< 0.001	< 0.0001	< 0.0001	

or negative correlation between IFN γ and QUICKI index. There was no significant correlation between IFN γ and fasting insulin, Spearman's correlation coefficient (ρ) was - 0.004 and the p value was 0.98. For McA, Spearman's correlation coefficient

68.4% of study group were primarily sub-fertile. 24 (85.7%) had polycystic ovaries (PCO) by the Rotterdam criteria

Table 2 Obese Lankan PCOS women had significantly greater IR when compared with the controls. This difference was evident in all three insulin resistant indices. Test was repeated in three times.

Difference in fasting blood glucose was not statistically significant. Serum levels of Testosterone, LH and FSH hormones were significantly high in PCOS group but the LH/FSH ratios were not significantly different ($p < 0.0001$). The mean IFN γ values were not statistically different between the two groups (table 3)

Table 3

parameter	PCOS	Controls	p value
Fasting serum glucose (mmol/l)	89.4(85.2-98.2)**	90.8(85.8-100.5)**	NS
Fasting insulin (μ U/ml)	49.7 ± 23.2 *	23.2 ± 9.8 *	< 0.0001
Triglycerides (mmol/l)	2.0 ± 0.7 *	1.8 ± 0.8 *	NS
IFN γ (pg/ml)	197(142-239)**	180(170-191)**	NS
LH (IU/L)	12.2 ± 5.8 *	6.8 ± 4.3 *	< 0.001
FSH (IU/L)	8.1 ± 2.4 *	5.9 ± 2.6 *	< 0.005
Prolactin (ng/ml)	9.3 ± 3.0 *	7.6 ± 4.3 *	NS
Testosterone (ng/ml)	2.1 ± 0.6 *	1.4 ± 0.7 *	< 0.0001
LH:FSH ratio	1.6 ± 0.9 *	1.2 ± 0.9 *	NS

Table 3 Bio-chemical results of women with and without PCOS. Mean ± SD, analyzed with unpaired t-test and the Median (IQR), analyzed with Mann-Whitney U-test

Correlation between IFN γ and insulin resistance by three different indices were analyzed. For the QUICKI index, Spearman's correlation coefficient (ρ) was - 0.11 and the p value was 0.54. There was no significant positive

(ρ) was - 0.16 and the p value was 0.41 and for HOMA-R, it was - 0.02 and the p value was 0.9. There was no significant correlation between IFN γ and McAuley index or HOMA-IR index in obese women with PCOS.

V DISCUSSION

This study was decided to detect any potential relationship of IFN γ in the development of IR and clinical symptoms of PCOS patients. In normal female, oestrogen upregulates the expression of TNF- α , and IFN- γ , which is important in endometrium receptivity and had been changed in in PCOS (31). In our study we found that there is no significant difference in IFN γ in test and control group of patients and couldn't find any significant relationship of IFN- γ with insulin level or IR either. This shows that IR in PCOS pathophysiology could be related by IFN- γ free pathway and it is strongly backed up by another latest research done by Juan *et al* about the importance of other marker like leptin taking part in process of PCOS highlighting the importance of the connection between leptin and inflammation in PCOS providing new insights therapeutic strategy for this disease(34). Several studies have proposed many pro-inflammatory molecules play a role in the complex inflammatory cascade that is associated with PCOS (31,33). With this data, we suggest that PCOS pathophysiology may be related to the IR in IFN- γ bypassing pathway.

Menstrual irregularity (oligomenorrhoea or amenorrhoea) was the most common phenotype among women with PCOS (27, 96.4%, 14). The median FG score was more than eight in PCOS, but this was less than the previous value observed in Sri Lanka (14). However, next study by the same researchers had found Lankan women with PCOS to be less hirsute (median FG of 10, IQR= 5) than originally found (15). We found that the FG score of this latter study is closer to the value observed in the present study (15).

Our findings shows that both PCOS and control group of participants shoed high FG score. This observation is compatible with the findings of an early study by Wijeyaratne *et al* (14,15). They showed that the normal Asian women were significantly more hirsute than their Caucasian counterparts. In contrast, USA study conducted in women with PCOS, suggested that the absence of hirsutism in Japanese women was probably due to the difference in dietary, genetic and environmental factors, interestingly, androgen hormone profile parameters were similar (16). In the current PCOS study group, polycystic ovaries (PCO) were present in 85.7% (n=28) and in control group it was 5.3%. Hirsutism is also high in PCOS patients as per the FG score and another group had found out that hirsutism in PCOS patients is not influenced by After comparing with previous research findings, we suggest that correctable etiological pathology in PCOS is mainly related to IFN γ bypassing system in IR. One research had found out that high levels of gonadal hormonal profile- GnRH analogues may

serum androgen levels, HOMA-IR nor anthropometric measures and more related to the metabolic disorder rather than to hyperandrogenism.

In our study, fasting glucose is normal in both groups and PCOS patient showed significant difference of fasting insulin and IR by all three indices. But BMI and Triglycerides difference is not significant. This finding is compatible with the research finding by kaluza *et al* about the central obesity can be the change of metabolism in PCOS and not related to the BMI (2). This shows us that triglyceride may not involve in the mechanism of IR in PCOS patients. Few more researchers had also shown significant association between IR with obesity and identified it as core mechanism of pathophysiology of PCOS (1,18,19) compatible to our findings. We hypothesized the central obesity would be the most reasonable key factor for this observation. Previous Sri Lankan team had also noted that higher FI and low insulin sensitivity in Sri Lankan patients with PCOS compared with patients with PCOS in UK(14,15). This can be explained with the concept of central obesity and Asians have been identified to have higher central body fat (25). They informed central obesity, not the BMI, is strongly correlated with IR related pathophysiology in PCOS (14,15). We noted that both PCOS patients and controls group were obese and all are insulin resistant in the present study. But the PCOS group shows significant higher IR values than the control group. Dunaif *et al.*, (1987) proved that IR is strongly related to the metabolic changes of PCOS (27). Therefore we suggest that PCOS is not directly related to the BMI and there should be other metabolic pathway leading to increased gonadal hormonal secretion ending with PCOS pathology (22,23). We observed significantly high testosterone, FSH and LH levels in PCOS patients when compared to the control group. The hepatic production of sex hormone binding globulin (SHBG) has been found to be inhibited in hyperinsulinaemic states and this has enabled this protein to be used as an indicator in the screening for insulin resistance (23). This inverse relationship was found to be present among insulin resistant South Asian PCOS women and their SHBG levels were significantly reduced (Wijeyaratne *et al.*, 2002). Due to economic constrain SHB was not measured in the current study

lead to insulin resistance and imbalanced body fat distribution (20). Another research group had suggested adiponectin secreted by adipose cells and is related in the pathogenesis of metabolic syndrome (21). Adiponectin can regulate glucose

and lipid metabolism, increase insulin, inhibit glycogenesis, anti-inflammation and protect blood vessels. Further adiponectin can control the hypothalamus to decrease appetite and resist obesity, and increase insulin secretion and regulate the sensitivity of insulin in the target tissue(21). Our results is further in favour of these finding indicate that PCOS patients have high IR and high gonadal hormone but not significant IFN γ mediated inflammation, obesity and BMI. Development of PCOS can be strongly related to the mechanisms other than obesity and most possible explanation is adiponectin mediated pathway. Our study showed IFN γ is not elevated in both PCOS and control group. Several *in-vitro* Considering all our results after comparing with previous research findings, we suggest that correctable etiological pathology in PCOS is possibly related to common metabolic pathway for Conflict of interest

This work is self-funded and there is no conflict of interest

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Prescription Analysis of short dosage forms of metformin as monotherapy or combined therapy in type II diabetes mellitus; pilot study.

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Abstract— This pilot study was done to evaluate the prescribing pattern of insulin and metformin in both monotherapy and combined therapy used in type II diabetes mellitus in Sri Lanka. The study was conducted at community pharmacies and the data was collected for a week. Results shows that total of 67 prescriptions were male 59.7% and 40.2% were female. Individuals of the 50-60 year age category was the most risk group having DM and were prescribed with twice a daily, thrice a daily doses of metformin. Different dosage forms were used but the monotherapy was the more frequent prescription in type II DM. The study specifically signified the importance of using the slow releasing dosage form of metformin instead of double dose.

Keywords— diabetes mellitus, monotherapy, metformin, insulin, combined therapy

I. INTRODUCTION

A prescription is an important document of instruction between a physician and pharmacist in order to prescribe medicines. Prescriptions must be reviewed constantly to prevent irrational prescribing and wastage of medicines [1]. Diabetes mellitus (DM) is a chronic metabolic disease condition where the high glucose level in the blood that is not properly regulated by insulin [2]. DM is listed as one of the major non-communicable diseases in the world. DM accounts for a vast proportion of morbidity and mortality across all age groups globally. DM has categorized into two types; Type I and Type II. In Type I DM, the body doesn't produce enough insulin and Type II DM, the body cells do not respond to insulin effectively or insulin resistant [3]. 90% of diabetes mellitus is identified as Type II DM and related to both insulin resistance and insulin deficiency [4]. A previous study conducted by Wade *et al.*, (1973) in revealed that 20% of general practitioners prescribed metformin as the oral anti-diabetic drug for the treatment for Type II DM and 1343 prescriptions were identified with the insulin [5]. According to the research done by Lee & Morley, Metformin is the typical oral anti-diabetic drug that is commonly prescribed to Type II diabetic patients [6]. Even though insulin is often used in the treatment of Type I DM and it is also commonly used in combination therapy in Type II DM [3]. A previous research study was done by Yki-Jarvinen, concluded that the dose of insulin in combination therapy is lower compared to the administration of insulin monotherapy. The purpose of this observational study was to statistically analyse qualitatively and quantitatively monotherapy or combined therapy in Type II DM.

II. MATERIALS AND METHODS

This study was conducted by analysing the drug prescriptions to evaluate the antidiabetic prescribing patterns in Sri Lanka. The prescriptions were collected with consent of the patient from random community pharmacies for a week on alternate days and categorized according to the inclusion and exclusion criteria. The following data were summarized in a designed data entry form using collected prescriptions including antihyperglycemic medicines (insulin, metformin or both), the dosage of the medication prescribed and gender of the patient and age of the patient. Data analysis was performed using IBM SPSS 21.00 statistical package for windows.

III. RESULTS

Among the collected prescription, 67 prescriptions were selected for evaluation. According to the data collected, 40 (59.7%) were males and 27 (40.2%) were females. Most of the collected prescriptions were in the 50-60 years age category (Table 1).

According to the numerals presented in the above table the 50-60 year age gap is most at risk and most affected by type II DM

The data were further analysed to determine the count of patients prescribed with metformin, insulin and combined therapy. According to the analysed prescription data, 58 from selected 67 prescriptions were prescribed with metformin only and the remaining 9 prescriptions were prescribed with combined therapy of insulin and metformin. The results revealed that no patients were prescribed with insulin only among the already collected prescriptions. (Fig.1).

TABLE I
DEMOGRAPHIC DATA EVALUATED IN THE PRESCRIPTIONS

Demographic data	
Sex	
Male	(40) 59.7%
Female	(27) 40.2%
Age group in years	
20-30	(1) 1.5%
31-40	(4) 6.2%
41-50	(16) 24.6%
51-60	(29) 44.6%
Above 60	(15) 23.1%

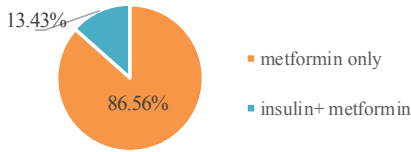


Fig 1 Percentage of prescribed medications; the metformin only medication was prescribed to a majority of patients in 58 prescriptions while only 9 prescriptions were prescribed with both insulin and metformin (combined therapy).

Analyzing the collected data on several doses of metformin prescribed by the physicians were found that, the most common dose was 500mg of metformin to be taken 2 times per day (bd) across all age groups (Fig.2). This accounted for a significant 61.8%. In some instances, the patients were advised to take 500mg of metformin tablets 3 times per day (tds) which is significant 10.9%.

According to the prescribing pattern of insulin, patients have administered 30 units in the morning and 20 units at night which was conveniently denoted as 30/20 units. However, due to non-existent of data for prescriptions with ‘insulin only’ medication, the data for combined therapy of 30/20 units of insulin combined with 500mg metformin was analysed. Statistical analysis demonstrated that combined therapy for type II DM was greatly practised for the patients with 40-50 year age category.

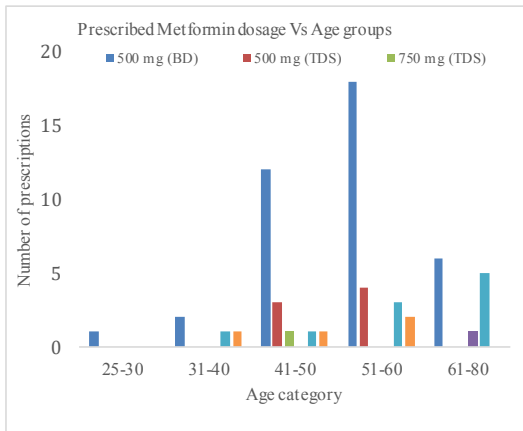


Fig 2 The abundance of metformin dosages in different age groups; analysis of metformin only prescriptions portrayed that 500mg (bd) was the most common dose of metformin prescribed across all age categories and the above dose was most prescribed in the 50-60 year age category.

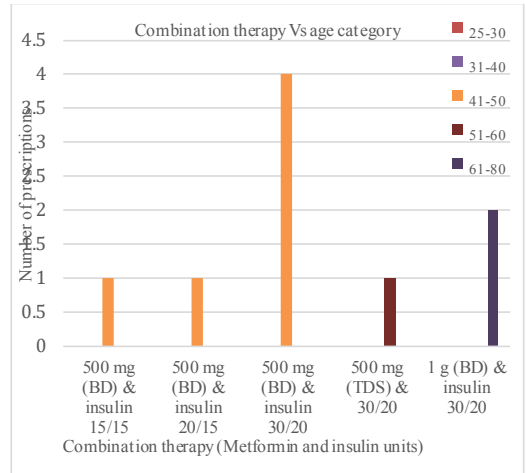


Fig 3 Abundance of combined therapy dosages in different age groups; analysis of 9 prescriptions of combined therapy portrayed that 30/20 units of insulin was the most common insulin dose and also combined therapy was seen to be prescribed more in the 41-50 year category.

The results show that most common drug in use for the type II DM was metformin (87%) and there was less variation in the dosages in which metformin was prescribed in both combined and monotherapy.

IV. DISCUSSION

Our study revealed that males were affected or at high risk of having type II DM when compared to females. Our results is compatible with the findings of Mahmood *et al.*, (2017) males were at high risk for type II DM due to the social habits and lifestyle changes in men [4]. Previous studies have revealed that macrovascular complications including ischaemic heart disease and stroke are the main causes of morbidity and mortality among DM patients. This risk is observed to be higher among the men who regularly smoke. [8]. They have difficulties in regulation, dosing of insulin and controlling their disease compared to non-smokers. The use of tobacco can increase blood glucose and IR as previously reported. Apart from that, consumption of alcohol has some adverse effects on DM like chronic pancreatic inflammation which can hinder its ability to secrete insulin [4].

This observational study also showed that the 50-60 years group was mostly prescribed for treatment with type II DM. According to the Mahmood *et al.*, (2017) and co-worker’s study, the age category 40-60 were most at risk for developing type II DM, who are the most committed and productive of their lives due to increase in work-related stress and physical body changes [4].

Metformin is the drug of choice for type II DM prescribed with 500mg tablets to be taken as 2 times per day, as observed in our study. In combined therapy, the same amount of metformin was coupled with 30/20 units of insulin. Most

diabetic patients were prescribed with different short dosage forms of metformin as monotherapy as well as of combined therapy. In chronic diseases, continuous lifelong treatment is a mandatory strategy and most of the research findings had shown that patients experience poor drug adherence and compliance with minimum control over the disease progression. This is compatible with our research findings of multiple therapy with short acting drug formulae for DM. With this pilot study, we suggest for medical professionals to re consider of substitution of long acting drugs instead of short acting formulations. This study can extend to evaluate the patients drug adherence and compliance on short dosage forms vs slow releasing formulae.

V. CONCLUSION

Our finding in this small scale study indicated that preponderance of male gender for type II DM through prescription via cross sectional survey. Most importantly there is obvious evidence for high frequent usage of for short dosage form of double dose (500mg bd) of metformin in the form of both monotherapy and in combined therapy with insulin. There is a significant number of other frequent dosage forms and we could not find any single use of slow releasing formulae. This is not suitable for the DM patients of age population to reduce poor drug compliance.

Therefore we decided to continue our study to research on patients drug compliance and drug adherence on therapeutic efficacy of DM.

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Smart Irrigation System for a Small Plant Nursery Based on Soil Moisture Level

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Abstract— This study is an examination about soil moisture level based on an automated watering system for a small plant nursery. The soil moisture sensors sense the current soil moisture level and send a notification to the user if the current soil moisture level is below than the required soil moisture level. Then the user should select the plant which requires watering, and then it displays the current soil moisture level and the required soil moisture level. To start watering automatically, the user must switch on the motor from the mobile application, and if not, he gets a notification to turn on the motor. The motor can be switched off by either from the mobile application or it turns off automatically. The main aim of this project is to develop a wireless smart irrigation system to provide irrigation which is automatic for the plants, which help in saving money and water in return. The main objective is applying the system for improvement of the fertility of the soil and the plant. The project aspires to defeat the challenges addressed above. The whole system is micro control based and can be operated from a remote location through wireless transmission. Hence there is no need to be concerned about the overflowing of water in the process of watering. In Sri Lanka, agriculture plays a vital role in the production of food crops and the economy. In our country, agriculture depends on monsoons which are not an adequate source of water. Therefore, the irrigation methods are used in the agricultural arena. Internet of things (IoT) is a turning point in the interpretation of technology. IoT represents an important role in many fields, one of which is agriculture by which responsible authorities are able to feed almost all the people on the earth in the millennium.

Keywords— Smart irrigation, IoT, Arduino, Soil moisture

I. INTRODUCTION

A. STUDY BACKGROUND

Most of the farmers use large extents of farming land, and it becomes very difficult to have access and track every corner of their large farming lands. Sometimes there are occasions of uneven watering. This brings about bad outcomes of vegetation which also ends in monetary losses. In this situation, the clever irrigation system using cutting-edge IOT era is helpful and results in ease of farming.

[1]. Following statistic shows the share of economic sectors in the gross domestic product (GDP) in Sri Lanka from 2008 to 2018. In 2018, the share of agriculture in Sri Lanka's gross domestic product was 7.87%, the industry contributed approximately 26.99% and the services sector contributed about 56.83%.

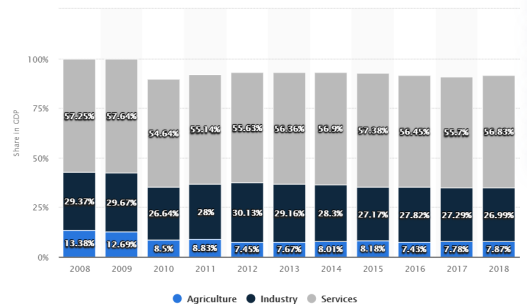


Fig 1: GDP in Sri Lanka from 2008-2018

(Source: <https://www.statista.com/statistics/728539/share-of-economic-sectors-in-the-gdp-in-sri-lanka/>)

In several parts of Sri Lanka, irrigation is administered manually. Concerning this smart irrigation system is thereby believed to be a major answer in the long run. This project presents a smart water irrigation system that optimizes the obtainable water within the water reservoir by providing an efficient and effective water usage solution for the irrigation system. The irrigation system is in a position to start and stop the pump by using the mobile app. There are 2 main factors that are effective in the growth of a plant or cultivation. They are water and varieties of soil.

According to the IUCN [2], the average annual rainfall varies from about 600 mm to over 5,500 mm across the island. Rain is received mainly through two monsoons: the northeast and southwest. Based on rainfall, four main agro-climatic regions have been identified in Sri Lanka: i) the wet zone, including the central hill massif, in the southwestern region of the island; ii) the dry zone extending over much of the flatlands in the north, northwest, east and southeast of the country; iii) the intermediate zone, separating the other two zones; and iv) the arid zone, in the northwest and southeast of the island are two tiny strip of lands — which are very dry and receive less than 600 mm of rainfall per annum[2].

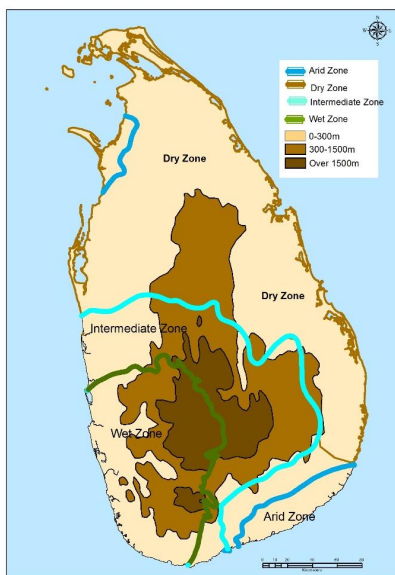


Fig 2: Sri Lanka’s topography and main agro-climatic zones
(Source: Drawn from the National Atlas, Survey Dept., 2007)

B. STUDY AREA

There are so many varieties of soil in Sri Lanka, and it differs from area to area. Therefore, the water requirements of different varieties of soil cause many problems with regard to watering.

Different species of plants need different varieties of soil to grow well. The soil types vary depending on the locality. The most abundant soil type in Sri Lanka is Reddish Brown Earths (RBE), Red Yellow Podzolic (RYD) and Low Humic Gley (LHG).

TABLE I: DISTRIBUTION OF THE SOIL TYPES IN SRI LANKA

(Source: NRMCC)

Agro-ecological region	Annual rainfall expectancy at 75% (mm)	Soil	Land use
Low country dry zone	650-1,300	RBE, LHG, NCB, RYL, Regosol, Old alluvial, Grumusol, Solodized Solonetz	Rain-fed upland crops; paddy; home gardens; forests; scrub; sugar cane; cashew; coconut; and condiments.
Low country intermediate zone	1,100-1,600	RYP, RBE, LHG, RBL, Regosol, IBL, NCB	Coconut; home gardens; export agricultural crops; paddy; rubber; sugar cane; rainfed upland crops; and citrus.
Mid country intermediate zone	1,100-2,000	RBL, RYP, IBL, LHG, RBE, Mountain Regosol,	Tea; vegetables; home gardens; paddy; forest; grasslands; and export agricultural crops; and rubber.
Up country intermediate zone	1,300-2,400	RYP, Mountain Regosol, LHG	Tea; vegetables; home gardens; export agricultural crops; forests; and paddy.
Low country wet zone	1,700-3,200	RYP, LHG, Bog & Half Bog, RBL, Regosol	Tea; rubber; coconut; home gardens; paddy; export agricultural crops; and fruit crops.
Mid country wet zone	1,400-3,300	RYP, RBL, LHG, IBL	Tea; home gardens; export agricultural crops; paddy; forests; and rubber.
Up country wet zone	1,800-3,100	RYP, Mountain Regosol	Tea; forests; vegetables; pasture; and home gardens.

Although there are differences in soil varieties in different parts of the country, this research solely concentrates on the

soil type found in the low country wet zone which is very suitable for home gardens.

Furthermore, in the project, all the plantations are done in one type of soil for every plant. Also, the project is based on the water saturation of the plant in a particular soil type and the water need of the plant in that soil type.

II. LITERATURE REVIEW

According to Patil and suyash’s research review paper [12] the machine learning is being applied towards grapes cultivation. In here, farmers are incapable of identifying the diseases on grapes, manually. The disease can be only identified after the infection, which takes lots of time. Therefore, accordingly, an agricultural monitoring system was developed by using, relative humidity sensors, temperature sensors and also the leaf wetness sensors.

The data collected at regular intervals are sent using Zigbee module to the server. The server here employs the hidden Markov model algorithm towards training the data sets pertaining to temperature, relative humidity and leaf wetness for analysing the data towards predicting the chance of disease on grapes prior to the infection. This information is sent as an alert message via SMS to the farmer and expert. The system employs machine learning in early and accurate detection of disease in grapes and suggests pesticide to protect the crop from disease and reduce manual disease detection efforts. Also, this system can be helpful for farmers towards giving information on the schedule of fertilizers, pesticide spraying, irrigation etc which would help in improving the quality and quantity of grapes [10]. The main drawback of this system is its inability to handle the system by farmers because of their lack of knowledge in the technology and the literacy problems [12][13].

According to Patil G.L. and Gawande P.S. [8] in the journal of Smart Agriculture Systems based on IoT and its Social Impact they have proposed system with the highlighted features of smart irrigation with smart control based on real-time field data. Secondly with temperature maintenance, humidity maintenance and other environmental parameters. It is a system which collects various data from the sensors like temperature, humidity, lux, moisture and other environmental factors and will do the analysis on the same. During the time period of the analysis if the system gets better results from the combination of the data which are collected through the sensors, they save them. In the system they are using IoT as the platform for the analysis process. The system will contain many modules from various geographical positions, and all those modules will send all the data to this platform, which will give some idea to be focused on the environmental factor, which will be good for the crop as well as the farmer and the cultivation [8].

The system consists of mainly two sections; the agro logger and the cloud interface with the mobile application. Furthermore, the whole system presents an agro logger system which is capable of sending and receiving data from the various sensors and to get updated data from the cloud.

The main drawback of this system is that it gets only data from the sensors of environmental factors. They have not focused on the effectiveness of the climatic changes and the damage caused to the system by the external parties such as animals, insects, microorganisms etc. [8].

According to Indu *et al.* [9], this has mainly focused on the reviews in the field of remote control and monitoring the technology which has used. And they are proposing an innovative Bluetooth/GSM model based remote controlled embedded system for irrigation in agriculture. The framework sets the watering system time depending on the temperature, and humidity perusing from sensors and type of crop can consequently water the field when unattended. The information is exchanged between ends via SMS and GSM network. The system informs users about many conditions such as status of electricity, dry running motor, increased temperature, the water content in soil and smoke via SMS on GSM network or by Bluetooth [9].

Still many farmers are using traditional agricultural methods which are very slow and not precise and accurate when it comes to the size of crops, quality, time etc [14]. As such the main goal of this project is to improve the quality, amount of the crops while keeping the cost at low by using of smart monitoring system which monitor's the soil temperature and moisture, pH level, humidity, storage level and rainfall. The main challenge for this system is to convert traditional methods to new systems which are connected with the technology all the way. So it may be a massive problem the farmers may encounter with their literacy and as well as the lack of knowledge regarding the updating technology. They are planning to develop this system to a more accurate one in future also to be integrated with solar power running and irrigation monitoring while it becomes more user friendly for farmers or any other users [14].

According to Srithi Rawaal [6] research paper, he proposed an automated irrigation system which monitors and maintains the desired soil moisture content via automatic watering. To implement the control unit microcontroller ATMEGA328P on Arduino Uno platform is used. Soil moisture sensors are used to measure the exact moisture level in soil in the setup. This value enables the system to use an appropriate quantity of water which avoids over/under irrigation. IOT is used to keep the farmers updated about the status of sprinklers and the irrigation system. Data retrieved through the sensors are regularly updated on a webpage using GSM-GPRS SIM900A modem through which a farmer can check whether the water sprinklers are in operation or not at any given time. Also, the sensor readings are transmitted to a Thing speak channel to generate graphs for analysis [6].

Data mining algorithm is used to make decisions on the drip irrigation system. Automated drip irrigation system having WSN placed all over the farm and different type of sensors [15]. WSN uses an ad hoc network, which gives self-configuration and flexibility. Sensor data are given to base station, and data are received using Zigbee. The data processing is done at the base station for decision making. The data mining algorithm is used to decide on data from the sensor to drip. All observations are remotely monitored

through web application. This system works on the Naïve Bayes algorithm for irrigation control. The algorithm works on previous data set for decision making if any attribute is not the frequent result is zero [16].

Rajalakshmi and Devi [17] have mentioned in their research paper, a system is developed to observe crop-field using sensors (soil moisture, temperature, humidity, Light) and automate the irrigation system. The information from sensors is sent to the web server database using wireless transmission. In the server database, the data are encoded in JSON format. The irrigation is automated if the moisture and temperature of the sector fall below the brink. In greenhouses, light intensity control may be automated additionally to irrigation. The notifications are sent to farmers' mobile periodically. The farmers can readily monitor the field conditions from anywhere. This technique is going to be more useful in areas where water is scarce [17].

Smart farming is an emerging concept, because of IoT sensors capable of providing information about their agriculture fields. The paper aims to make use of evolving technology, i.e. IoT and smart agriculture using automation. Monitoring environmental factors are the major factor in improving the yield of efficient crops. The feature of this paper includes monitoring temperature and humidity in the agricultural field through sensors using CC3200 single chip. The camera is interfaced with CC3200 to capture images and send that pictures through MMS to farmers' mobile device using Wi-Fi [20].

Vineela and Nagaharini [19] have proposed to monitor crop-fields using sensors for soil moisture, humidity and temperature. By monitoring these parameters, the irrigation system can be automated if soil moisture is low [19].

III. PROPOSED SYSTEM

1) MOBILE APP DESIGN:

The system wants to monitor the details gained through the database and the Arduino IoT circuit. Hence compulsorily the system should have a process to monitor those details. That system can be a web application, website or a mobile application. Among them, the most suitable solution to monitor those data is a mobile application. There are lots of reasons to choose to develop a mobile application. Such as mobile device is easy to use and it is designed by the Android, as well it is easy to maintain, and its availability is high all around the world. Android devices are the devices mostly used in the world. The user can successfully access the system by using an android application. It is easy to use a mobile device which can hold in the palm rather than using a laptop or a PC.

In the designing phase of the mobile application, for the background green was chosen because it is considered as the colour of nature, life and it is associated with the meaning of growth and the environment. The green colour can enhance vision, and it takes up more spectrums visible to the human eye and it is the dominant colour of nature.

The “OFF” button in the application has used the red colour as it gets highlighted at first sight, and it is the standard colour for something to stop it.

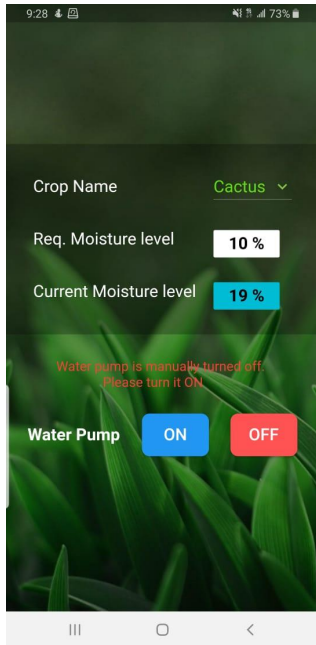


Fig 3: Mobile app interface

In this project, a database is necessary to store data regarding the soil moisture levels of different plants. As the system is a real-time one, the database also should be a real-time database platform. It should have cloud storage.

The benefit of Firebase hosting allows you to set-up a single page, a mobile landing page, web page or progressive web page with ease. It also helps to deliver the content rapidly anywhere.

2) ARTEFACT AND CIRCUIT DESIGN:

The diagram given below is an overall block diagram of Arduino based smart irrigation system which consists of the soil moisture sensor which is connected to the controller and sensed values from those sensors are sent to the mobile application.

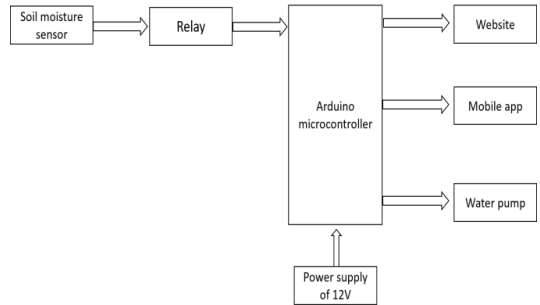


Fig 4: Block Diagram

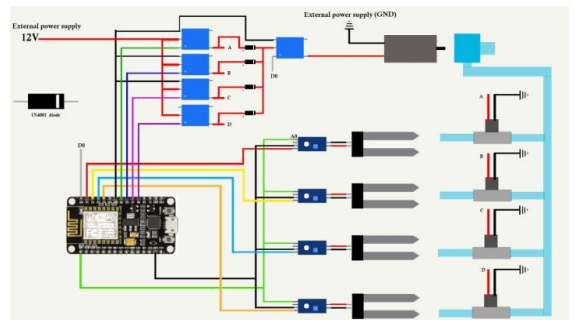


Fig 5: Circuit Diagram

As the outcome of the mobile application, providing a drop-down list of plants by the app, displaying the required soil moisture level gained through the artefact and providing an interface to log in to the account in the mobile application was expected.

By creating a database, the system is expected to store the related data and to retrieve data and to compare the values of current soil moisture level and the required soil moisture level.

The artefact is the only tangible part of the system. It plays a major role within the system, and it does the most important tasks. Detecting the current soil moisture level accurately, controlling the water pump and the watering valve are the areas which are expected to cover by the artefact.

IV.DISCUSSION

The academic question which was selected for this project was “What are the main challenges involved to build up a smart irrigation system?” and the main challenges encountered by the farmers who use a manual system for watering are, the water scarcity, withering or dying of plants due to over watering or less watering and the problems arisen with the updating technology in a globalized world. The agriculture sector is also getting updated with the trending technologies, and it was a reason to build up this type of a system to do the watering.

In the system which has developed, the user gets a notification when the current soil moisture level is below the required soil moisture level of plants. Then the user turns on the water valve manually via the app or if not, the system gets automated, do watering and sends a notification to the user when the system gets started.

Therefore, it may not cause to a less watering or an overwatering of the plants, and it will do watering in a better way more accurately.

When the expected results are obtained, the entire system works according to the project plan, which was designed at the beginning of the project, and then the system performs very accurately and efficiently.

Firstly, the user must create an account and should have a login to the account to get updated about the details of how the system works.

The soil moisture sensors detect the current soil moisture level of plants.

Furthermore, if the current soil moisture level is below than the required soil moisture level, the user gets a notification to the mobile device via the Wi-Fi connection.

If the water pump and the valve have been switched on previously from the mobile app, the system gets the water pump and the water valve switched on automatically and it sends a notification to the user as well. It starts watering again and it sends a notification as to which plant is getting watered at the moment.

If the user turns on the motor manually, firstly user should login and select the relevant crop from the drop-down list displayed in the mobile app interface.

After selecting the crop name, it displays the required soil moisture level automatically by retrieving the data from the database.

Thereafter in the mobile app, it displays the current soil moisture level, which is detected by the soil moisture sensors and compares the values of required and the current levels of soil moisture.

The user gets a notification to do watering only if the current level of soil moisture is below the required level. If not, he does not get any notification.

While watering, if the current soil moisture level is equal or higher than the required soil moisture level the water pump will automatically get switched off and stop watering.

And, the user receives a notification which contains a message that the watering process has stopped. All the notifications will display in the notification bar of the mobile device.

This project is done by using only soil moisture sensors according to the soil moisture level of particular plants. Most of the projects based on the soil moisture level were based on the water saturation level of the soil type. However, here in this project, it has used the different water levels needed for different crops.

To improve the efficiency and the effectiveness of the system, this can be developed to a large cultivation land which the watering system is fully automated. Then it requires less manpower.

Hence as future enhancements can remove all the limitations in an efficient way and expand the project scope.

When developing and implementing this system further, different types of sensors like soil moisture sensors, humidity sensors, temperature sensors, rain sensors etc can be included. Then there is a possibility of gaining the most accurate data from the system.

The advantage of using IoT for the irrigation can come in handy for further activities in farming such as cattle management, climate control. This would lessen human mediation in farming activities.

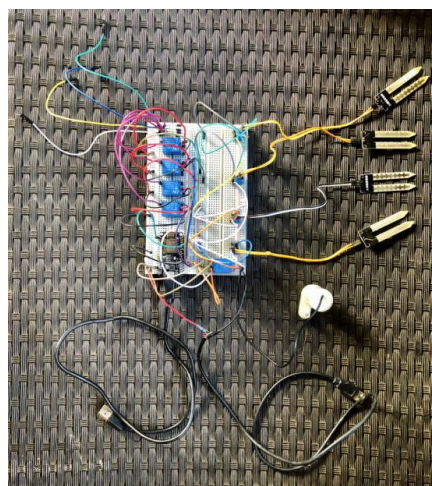


Fig 6: Arduino Circuit

V.CONCLUSION

This review and the project involve establishing a contemporary design technique of smart irrigation system for a small plant nursery based on soil moisture level. It is a system designed to check the soil moisture level and the water need of the plants, and the project provides an opportunity to study the existing systems, along with their features and drawbacks.

The proposed system can be used to switch on/off the watering valve according to the soil moisture level of the plant thereby automating the process of irrigation which is one of the most time-consuming activities in farming.

The system uses information from soil moisture sensors to irrigate soil which helps to prevent overwatering or under watering of soil, thereby avoiding the damage to the plant. Through this project, it can be concluded that there can be considerable development in farming with the use of IoT and automation.

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Leading the Children in Sri Lanka to Right Choice of Education

Professor Lalith Edirisinghe

Note:

This article is a brief communication of the original research presently being conducted by the Faculty of Management and Social Sciences of CINEC Campus. The author believes this will be useful to many researchers, and will undoubtedly stimulate further research in the field of education. Following the norms of research writing, some experimental details haven't been incorporated in this briefing since the author is yet to publish a series of original research manuscripts.

Preamble

The University of Ceylon was established in 1942 by the Ceylon University Ordinance No. 20 of 1942. According to the Universities Act No. 16 of 1978, more Universities of independent identities were established but the state has been controlling them through the University Grants Commission (UGC). The amendments made to the University Act in 1999 allowed state Universities and private institutes to grant undergraduate and postgraduate degrees. It has been estimated approximately 300,000 students per sit for GCE A/L examination annually in the local streams and almost 180,000 obtain minimum entry qualification for tertiary University education. Nevertheless, only around 30,000 students are fortunate to enter a state University every year. The rest of the 150,000 students who can be considered as victims of circumstance are deprived of state University education. Although the government has allowed international schools to boom, the students who get through London G.C.E. (A/L) are not absorbed by the state University system.

As a result these students are compelled to continue their tertiary education overseas or at home spending a substantial amount of money every year. Sometimes it is pathetic to find a fair number of students qualified to follow degrees are totally deprived of tertiary education. The youth may consider this as unfair practice and gross discrimination. On the other hand a huge amount of foreign exchange is drained off on tuition fees and overseas accommodation. It's been estimated that more than 12 000 Sri Lankan students travel overseas annually to pursue their higher education. The calculations show the annual loss of foreign exchange amounts to more than \$ 50 million. Even if the students follow a degree awarded by a foreign university staying at home country, the foreign exchange is lost by way of royalty fees and other affiliation charges.

Psychological paradigm shift in students' demand and enrolment for various academic disciplines

Accelerating Higher Education Expansion and Development (AHEAD), Ministry of Higher Education in its objective of results area one, stresses to increase enrolment in higher education programs that are of strategic importance to economic development. Due to its vital importance, every institute of higher education is expected to pay undivided attention to it. According to the Employability Survey Report 2017 of Wayamba University of Sri Lanka (ESR – WUSL), the percentage of unemployed graduates in its 12 departments at the time of

the survey was 37. This situation should be seriously taken into consideration since these graduates have been unable to contribute to the economy not because of a fault of their own but due to an unrealistic education system. These statistics adequately prove that there is no return on investment from the most intelligent and qualified young talent of the country. Further, the quality of graduates as well as the acceptance in commercial establishments currently vary considerably. On one hand, the high-end graduates are nationally and globally employable, while others struggle to find suitable employment. These differences reflect sharp variations in the quality of programs and the socio-emotional skills (employability skills) of students. Although the Interest Free Loan Scheme (IFLS) is a strategic approach in this context, the limit of the loan facility (i.e. maximum Rs.200,000.00 per annum) hinder students choosing their most preferred study area for their degrees. Consequently, they will have to settle with the degrees offered at the minimum cost. The authorities concerned have been made aware of these particular circumstances in view of prompt solutions or alternatives.

The pending employability crisis requires the country to curb graduates in areas that has no potential employment opportunities. It can be argued that a graduate should be able to carry out any job better than a non-graduate and it is up to the commercial establishments to follow suit. However, employers always prefer to recruit undergraduates only from relevant disciplines. If the country produces more and more unemployed graduates, the ultimate impact to the economy and society will be unbearable. This will lead to critical repercussions unless a systematic approach is introduced through scientific researches.

In recent years more students have been able to enter tertiary education due to additional capacity created by the non-state universities and government's initiatives of IFLS through non state education institutes. In addition to the degree programs offered by foreign universities, non-state higher education institutes commenced diversified and futuristic degree programs approved by University Grants Commission and Ministry of Higher Education. However, it is evident from the available statistics that most of the students tend to select very common degree programs and the demand for innovative academic disciplines are very low. Most of the non-state Universities also cater to the present demand and only a very few institutes volunteer to conduct these new disciplines on experimental basis even at substantial financial losses. This trend will lead to heavy competition for graduate employment in the next few years unless the students in the future are properly guided in their selection of field in tertiary education. While the students entering state-Universities are compelled to settle with the decision of University Grants Commission based on the Z score, most of the other students who enter non-state sector seek advice from parents, siblings and schoolteachers. The present research on "Development of a mechanism that leads to a psychological paradigm shift in students' demand and enrolment for various academic disciplines in the tertiary education in Sri Lanka" is a project funded by the World Bank. It is carried out by the Faculty of Management and Social Sciences of CINEC Campus.

The Research Reconnoitres

The tertiary education in Sri Lanka is faced with two fundamental challenges. On one hand out of those passing the G.C.E. Advanced Level Examination only 17% enter Universities while 83% are left behind. Nearly 130,000 students annually are deprived of the opportunity to proceed with higher education due to the resource limitation. This means, during the last

40 years, millions of students in Sri Lanka have sacrificed their rights for education still without a sustainable solution. On the other hand, there is a higher unemployment rate of graduates in the country even after this competitive selection process. While those who are deprived of an opportunity to pursue their higher education despite them qualifying, their future is unwelcoming for no fault of theirs. As per reports by the Department of Census and Statistics, the highest unemployment rate (9.1%) is reported from the G.C.E. (A/L) & above group in Sri Lanka. It is 5.1 percent and 13.2 percent for male and female respectively, 2018. As at 2017, the total number of unemployed graduates in Sri Lanka was 34,316. Among the unemployed graduates, about 54 percent are Art degree holders while the other 46 percent consist with other degree holders. Considering the above background of tertiary education in Sri Lanka, the higher unemployment rate of graduate is not only a problem of theirs but also of others who have become victims of circumstances and sacrificed their lives in this unhealthy competition. It may cause problem to the tax payers who help the government provide the so-called free education in universities. The situation also affects their parents and other family members who contributed a major part of their lives to make them graduates.

The undergraduates who enter government Universities after a very competitive selection process in Sri Lanka are bound to be unemployed mainly due to mismatch of employers' requirements in the modern world and the skills and competence they have developed in the tertiary education. It is therefore timely, if not already late, to develop a mechanism that leads to a psychological paradigm shift in students' demand and enrolment for various academic disciplines in the tertiary education in Sri Lanka. There are a number of criticisms that the following of degree programs conducted in government universities do not result in creating a graduate that the commercial world demands in the present context. Therefore, it is high time that state Universities introduce degree programs in emerging fields so that non state Universities can also follow suit. Traditionally, there has been a tendency by students to prefer subject areas of degrees introduced in government universities. The reality of students' choice for higher education was evidenced in the recent IFLS that there is a higher demand for the common programs conducted by the state universities. It is however sad that the job opportunities for those common degree programs are low even in the current situation. Therefore, more students following similar programs could lead to a serious problem in the years to come and some remedy should be required as early as possible. The proposed psychological paradigm shift in students' demand and enrolment for various academic disciplines would be a sustainable solution to the above issues.

In one way, the contribution from the non-state higher education is emerging and these institutions will respond to the demand immediately and cater to the shifted paradigm. Therefore, this research will mainly question factors that lead to a psychological paradigm shift in students' demand and enrolment for various academic disciplines in the tertiary education in Sri Lanka. In most cases, the advice the students get about selecting the subject area are usually based on highly subjective parameters and mostly based on out-dated information. For example, a parent giving advice to his child to join a field that proved successful twenty years ago is not the ideal choice today. In fact, the present choice should enable students to make their life successful in the next 30 years to come. Therefore, guiding students in the right direction for their tertiary education is a timely need and becoming more important than ever before.

Implementation Perspective

The term “Customer” in tertiary education is different from that of manufacturing or other general service sector. The student uses the service offered by the education institute while the parents (in almost all cases in the Sri Lankan context) act as the “customer” who pays for the services provided by the institute. In the recent years more students have started entering tertiary education due to increased options available. In addition to the degree programs offered by foreign universities, non-state higher education institutes commenced diversified and marketable degree programs approved by University Grants commission and Ministry of Higher Education. Therefore, the number of graduates may increase significantly in the years to come. In addition, the IFLS students may enter new degree programs offered by non-state higher education institutes in various demanding disciplines if the limits of loan amounts are increased. The main concerns raised by CINEC in the recent policy paper is under the education project funded by the World Bank includes, inter alia, the need of vertical integration between schools and higher education institutes, review in the school curriculum, introduce more academic disciplines at tertiary level, and formal recognition of different skills of children rather than creating statutory boundaries that restrict their inborn talents. The vertical integration between schools and non-state higher education institutes/State universities develop formal links between schools and non-state higher education institutes/State universities to share knowledge. It also increases the awareness of the emerging areas that has more job opportunities and recognition. Introducing evolving new academic disciplines in the school curriculum in a systematic manner are also important since there is no formal mechanism to create awareness about global demand of job market to students. Their mindset is limited to traditional academic streams such as Medicine, Engineering, Accounting Human Resources, Business administration etc. This mindset needs a comprehensive transformation in order to expand the horizon of academic disciplines to students at tertiary level. It is practically impossible to facilitate new disciplines (or even increase the intake of handful of existing evolving disciplines due to capacity constraints. However, presently non state higher education institutes offer a wide range of programs under many disciplines but due to nature of the programs the tuition fees are relatively higher. It is also suggested, at the very beginning in the early childhood education and in schools, skills strategies should prioritize the formation of cognitive, behavioural and social skills of the students by applying different learning teaching practices for example, problem solving methods, cooperative learning, project method etc. Good cognitive and social and behavioural skills are essential for gaining and improving technical skills throughout life.

Conclusion

Education is not limited to acquisition of knowledge. Therefore, tertiary education should focus not only on knowledge in a specific area but also on the development of skills and competencies of the graduates. It has a direct influence and essentially deals with many indirect transformative processes. However, it can also be argued that educational processes and practices are influenced by social phenomena which are evident in every culture and nation. Moreover, education is vital for success in human endeavours and its impact on quality of life is boundless. In such a context, employability is a key concern and is in a state of flux linked not only with inventing and adapting to latest technology but also developing CSR strategies to promote democracy, gender equality and eliminate poverty in society. It is also important to note that the choice of higher education for a diversity of requirements is

usually influenced by peers, siblings, parents, and academic staff at secondary level, government, and employers. One critical issue faced by non-state universities is the non-funding by the government which make them find their own financial sources. As a result they are unable to offer a wide range of degree programs for students and limit themselves only to a few popular degree programs. The popular trend in line with commercial competition and global education practices may have produced more graduates in the society a few years ago. It is argued that there is no free education in Sri Lanka as claimed by some politicians because the state university education is facilitated by the taxpayers' money in the country making it come at a price to the society. Yet, the outcome has been unsuccessful as there are already considerable numbers of unemployed graduates in the country. The picketing carried out every other day display social unrest and the ultimate return on investment (ROI) to the taxpayers' money and the loans borrowed from other countries at higher interest rates to develop education sector. The economic impact of these issues is not difficult to understand. In conclusion, the witnessed failure is not the total fault of students but those who direct them to be graduated in such unemployable academic disciplines.

General information

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Full length original research papers should include the following: Title page, Highlights, Graphical Abstract, Abstract, Key words, Introduction, Materials and Methods, Results and Discussion, Conclusion, Acknowledgement of sources of funding, Statement of Conflict of Interest, References, Tables and Figures. The maximum number of words for a research article is limited to 10,000, including figures, tables and references. Each Table and Figure will be counted as 400 words. Longer articles will be considered by the Editorial Board only under exceptional circumstances, based on the scientific contents.

Review papers should include an Abstract, an Introduction that outlines the main points, text under brief sub-headings and References. Review papers are generally limited to a maximum of 20,000 words including figures tables and references. Each Table and Figure will be counted as 400 words. It is a requirement that the reference list of a review article should carry at least five articles related to the research area concerned published by the author of the manuscript. Longer manuscripts, such as Checklists, will be considered by the Editorial Board only under exceptional circumstances, based on the scientific contents.

Short communications should contain novel findings written in the form of a concise, independent report representing a significant contribution to the field of study. It should be written under the subheadings as in a research paper but should include only few key references. It may include a 1-2 tables or figures and the word count should be confined to a maximum of 3,500.

Research notes briefly explain new research findings. The word count should not exceed 2000 words.

Reviews of scientific books should be comprehensive and should not exceed 2000 words.

Opinion should be written on a topical theme in the form of a concise, independent report. It should not exceed 1500 words.

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